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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XIII FEBRUARY 25, 1924 NUMBER 3

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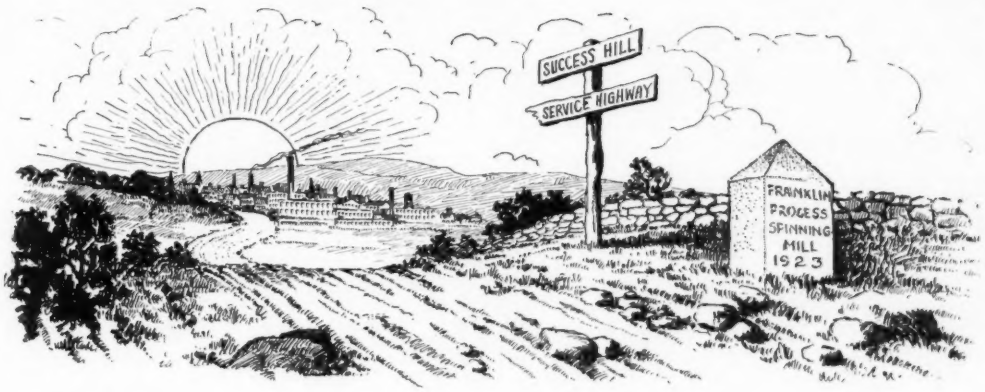

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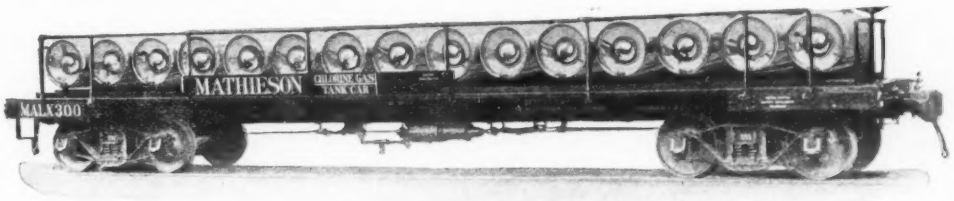

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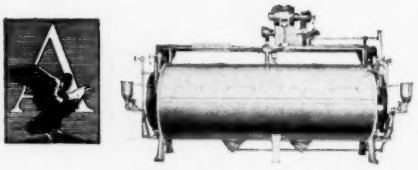

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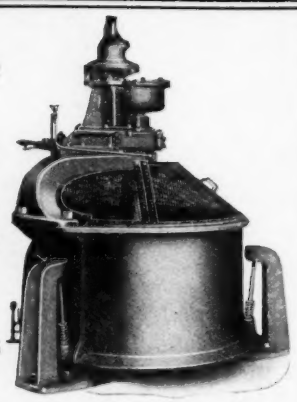

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VOLUME XIII NEW YORK, FEBRUARY 25, 1924 NUMBER 3

Selection and Control of Most Suitable Dyes for Production of Recurrent Colors

Objects of Scientifically Controlled Dyeing—The Single-Purpose Dye—Method of Maintaining Standards in the Dye—Application to Dyeing Formula—Manipulation Control—Analysis of the Method

By HIBBARD S. BUSBY

Objects of Scientifically Controlled Dyeing

ONE of the chief factors that have promoted investigation of the dyeing process in recent years is the necessity of reducing the cost of the operation to its ultimate minimum, while at the same time removing the annoyances bred through unstabilized output.

In fact, back of every attempt of large dyehouses to improve the process is the composite motive of stabilization, improvement and reduction of cost. Try to determine which of these comes uppermost and you will almost certainly discover they are so closely related as to be a part of one of those so-called "vicious circles" whose relentlessness is too well known to management.

Closely bound up with this composite motive is the necessity, from the very start of operations, of standardizing and making into matters of routine as many as possible elementary operations of the production. The necessity of doing this is the necessity of eliminating troublesome details to as great a degree as possible in order to achieve economy in time, annoyance and resultant costs.

The third necessary accomplishment is that of converting all repeat production into routine form rather than a constant source of new effort and semi-experiment. Even in the most varied production there is enough work encountered which may be treated in the manner described above to not only be worth the effort, from a financial point of view, but to make the changes effected contributory to ability to compete more efficiently, in other respects, in the market which consumes the product.

Of a certain degree of importance to the problems of selection of materials, method of application and quality of production, the matter of choice of type of dye suitable to each item of product is susceptible to analysis to a degree which makes it possible to distinguish dyes that have only general properties from those having specific properties highly adaptable to the dyeing of a limited number of shades.

The whole matter of the tests which determine the complete story of properties and possibilities of a dye is too large for one discussion; it will be necessary to concentrate for a time upon the type of dye with limited uses, described herein.

The Single-Purpose Dye

Within the range of dyes adaptable in a general way to a given fiber by reason of their chemical nature, fastness, solubility and other properties which constitute the preliminary conditions of admission into a certain practical dyeing group, there are certain dyes whose tinctorial qualities are such as to be superior in utility for the production of one or more colors that are in constant demand. These dyes, adaptable usually when used alone to production of only a single color or very limited range of colors, are also so *decidedly* suitable to such application as to merit the conception of being single-purpose means of production and are a decided economy in that role.

Examination of numerous formulas for the production of piece dyed goods discloses that whereas the individual dyes in the formula may each contribute a strength percentage anywhere from one-tenth of 1 per cent up, the total formula usually runs from 3½ to 6½ per cent, and 5 per cent is a good average. On the other hand, those formulas which are the result of the use of one ingredient, principally, frequently go as high as 10 per cent, but as a rule seldom average above 8 per cent. If a study is made of the color produced by dyeing a fiber with the various percentages of a dye, starting with one-tenth of 1 per cent and running up, in geometrical progression, until the maximum color effect is reached, certain definite phenomena are noticed which furnish the key to very important facts in the economy of dyeing. First of

all, the hue will be somewhat grayed or whitened in the lower percentages, due to the fact that the natural color of the fabric is preponderant over the effect of the dye upon it. As the strength of the dyeing is increased the definite characteristic hue of the dye makes itself evident and *remains practically unchanged through the higher percentages,* being subject only to certain degrees of darkening and dulling in the higher percentages. Carrying the dyeings out to extremes, it will be seen (as every dyer is aware, to a certain extent) that the limit of effective dyeing power is shortly reached and further attempts to increase the dyeing percentage are futile, dyestuff failing to exhaust from the bath and no appreciable color advantage accruing to the fabric; indeed, the reverse shortly takes place.

Study of a considerable number of dyeings made in various convenient ranges of percentage shows that certain qualities of the dye may be determined from the character of the color change shown in these dyed steps. These effects are measured in terms of:

1. The percentage required to first show characteristic hue.
2. The percentage to overcome fabric color.
3. The rate at which color strength increases per percentage of dyeing concentration.
4. The limit of color percentage effectiveness.
5. The degree of adherence to characteristic hue as dyeing strength is increased to the effective limit.

In any case a dye cannot be said to be suitable, economically, to dye a characteristically uniform shade regularly required (as well as the shades closely approximating this shade) unless its hue strength is of gradually increasing degree as the dyeing percentage is increased to the effective limit. It is frequently possible to dye a color almost exclusively with one dyestuff, but if the conditions stated above are not realized in the dye used it will be found to be very uncertain, in successive lots and, in fact, in successive uses, and cannot be used in a definitely calculated formula basis of production where it is to be almost the *sole* dye used for dyeing a given shade which must be maintained throughout a long program of production.

Due to the condition of characteristic strength percentage in dyeing formulas (noted above), it has been found that no dye can be used, economically, for this purpose whose maximum tinctorial power is in excess of 12 per cent, and it is better if it be no higher than 10 per cent.

A characteristic color formula expressive of the desirable condition can be written; and while this work has not progressed over the total range of dyes available commercially, to determine with certainty all the factors which may influence the determination of this formula, to date the figures given above seem to hold good for enough cases to indicate the validity of the formula for use in acid dyes and a considerable number of basic dyes.

A dye may be an effective single-purpose dye and still require certain slight modifications in shade to satisfy the conditions of production; i. e., it may be the dye best suited to the effective, economical production of a color that is only possible of attainment through modification in shade by another dye or by variation in the method of its application. Some interesting examples of this have appeared from time to time in the reported discoveries of special new uses of particular dyes that differed markedly from the uses to which the dyes are most commonly applied.

This limiting factor may be attached, however, that in no case tested to date has the dye been properly used in the above sense if (1) the variation in hue from characteristic hue of the base dye (by reason of the modification with the second dye) is more than four times the total variation in hue throughout its scale of percentage dyeings (referred to above), nor if (2) the new method of applying the dye makes for a marked diminution in the other tinctorial properties (described above) when, under the new form of treatment, a scale of percentage dyeings is made and compared to the original scale made by the untreated method.

Method of Maintaining Standards in the Dye

As it is assumed that this dye will be employed in a formula of rather closely calculated proportions, it will be necessary to use more than the usual care in seeing that successive shipments are kept up to standard in their various properties. This means that the laboratory must be sure to see to it that very little leeway is allowed in a lot passed on to the dyehouse for use in standardized formulas. If the general characteristics upon which the dyestuff rating is made are *similar in character* (i. e., proportional) to those of the standard, a new lot can be brought up to standard at once by changing the amount of dyestuff to be boiled up per barrel of standard. If the characteristics of the new lot are dissimilar to those of the standard, the lot should in no case be used for this single-purpose production. In all events, very close color check should be resorted to as a basis of making this determination, and the refinement of suitable optical means rather than the ordinary procedure of matching should be depended upon for this rating.

This leads at once to a statement of what form the specification for delivery of successive lots should take. Speaking technically, it may be written in terms of the quotients and constants of the characteristic formula for suitable tinctorial properties of a dye, but for facility in practical description it does about as well to say that the dye should be capable, in addition to meeting its regular trade requirements, of matching certain specified colors at certain percentages of dye-

ing. These percentages are located at the salient points of the percentage dyeing scale, in such manner as to define the critical points peculiar to the particular dye.

Application to Dyeing Formula

The proper steps to take to insure standard conditions of dyeing have been discussed sufficiently in a professional way and in works practice as to be familiar to most textile chemists. Having these in mind, it is possible to go still farther and say that perhaps the most important factor influencing economy through standardized dyeing is the formula itself. To begin with, the average formula used in piece dyeing uses altogether too many colors. It is frequently a very simple matter to make up a dye bath (in the proportions of a portion of the elements in one of these formulas) which dyes a fabric neutral gray, although the formula itself is made for a very strong color. Obviously, the gray combination has to be overcome by excess of other colors—which excess is very certainly wasted. Where the proper dyestuffs are on hand for a certain grade of work there is no reasonable excuse for a dyeing formula calling for from six to eight dyestuffs, all more or less different in characteristic tinctorial properties. One of two things is pretty sure to be found to be the case under such conditions, either:

1. The wrong predominant dye has been chosen, or
2. Not having a predominant dye of the proper qualities, the attempt has been made to effect or pull up to the desired qualities by means of color changes, in first one direction and then another. Even the most cursory study of the effect of this latter procedure demonstrates its folly.

The fault for this condition may lie (1) with the dyer for selecting the wrong predominant dye; (2) with the one charged with the responsibility for the purchase of the dye, in that of all the dyes available some other factor of minor importance has influenced the addition to the list of standards of a dye less suitable than the most adaptable predominant one; or, what is most likely, (3) no definite study has ever been made of the matter.

Selection of the most adaptable dyestuff will not only reduce the number of auxiliary dyestuffs in a formula but will, in nearly every case, lower the dyeing percentage of the predominant color used.

Because the maximum effective tinting strength of a dyestuff is reached usually at a lower percentage than the percentage required by an improperly chosen predominant color, it follows that in the matter of proper choice of such colors lies a matter not only of economy but of quality of output and proper treatment of the fabric.

Tinting colors in very small percentages are, to be sure, perfectly logical auxiliaries to even a properly chosen chief color, but when several dyestuffs are available from which to choose the major color for a formula and the modifying color is required in more than one-fifth of the percentage of the chief color it is time to look for another dyestuff for the predominant color.

The selection of the modifying color is more a matter of the color distance away from the chief color than anything else. Also, there is very little excuse for a modifying color that is not stronger in its own hue than the comparative strength of the predominant color. Otherwise conditions are reversed and the situation of relative percentages then becomes anomalous.

Much of the fault in making dye formulas for routine production lies in the inability to visualize the exact relations between effective percentages of a color and of a group of colors. This difficulty can be entirely eliminated by the construction of and constant reference to an effective system of color-charting the various dyes. This gives a basis for selecting dyes best adapted to the various roles of predominant color, tinting color, etc. It provides, at the same time, for a background upon which to delineate the vital points of each single-purpose color as established, and becomes, therefore, a basis of reference for modification of established formulas or creation of new ones.

Manipulation Control

It is fully as important that the condition of standards which are to be drawn upon for dyeing on this basis be constant, as it is to insure that deliveries of successive lots are of constant quality. The necessary control of this factor may be attained by means of registering a colorimetric reading of the proper stand when first made up and checking against this from time to time as the contents of the barrel are reduced in volume. Particular care must be exercised to see that if more water is added in order to make up the loss occasioned by evaporation, that the new mixture is thoroughly accomplished, as certain dyes tend to suspension in layers of varying concentration unless extreme care in agitation and heating, etc., brings about a solution of uniform strength.

The same conditions which produce uniformity of result from the same elements in any process of dyeing should be maintained here. It is not that this is a system of dyeing that requires unusual attention to details to insure its success, but that the whole method of production on this basis is based upon definite measurements to secure the benefit of a measured result, calculable in advance. For this reason, and this alone, it is logical that measurement and exactitude prevail throughout. This is no more difficult nor costly (after the first experience) than slipshod methods.

Such matters, then, as volume of bath, dyeing temperature, pressure and agitation of steam used in boiling, etc., should be kept uniformly at the point found suitable for a given formula. For, as noted, at present

humidity has no effect on this system of dye production, except in cotton, and not to a disturbing degree there. The same sequence in steps of the actual dyeing operation should be maintained, however. Also thorough precautions should be observed for the proper cleaning of barks, sticks and other equipment prior to the entry of a different color lot. Even if a second lot of *any one color* is dyed so as to follow immediately a previous lot, care should be taken to see that no accumulation of "colored froth" or other residue remains sticking to the apparatus when the new lot is entered for dyeing.

These ordinary precautions of good dyehouse practice, if followed consistently, with the use of the controlled formulas described, will result in production that will survive color inspection of the most rigid type, not only by the unaided eye but even that of a colorimeter.

Analysis of the Method

In order to evaluate the method outlined above from a practical viewpoint a balance must be struck between effort and expenditure in outlay and benefits of an economic nature derived.

The actual preparatory work required for an extensive line of colors might possibly require the time of an experienced dye tester over the period of a whole year. This time would be spent in preparation of percentage dyeings, charting of colors and study of the various factors, to the end of proper choice of dyes adaptable to standard formulas.

Only the simplest kind of equipment is required.

This work would have to be done in close co-operation with the purchasing department, the laboratory, the color or quality inspection department, and should follow along the lines of the background already covered.

Against this investment may be listed the following permanent benefits to production, organization and business stability:

1. Trouble and uncertainty saved in establishment of proper elements in routine dyehouse formulas.
2. A sound and merit basis of making advantageous term contracts for the purchase of individual dyestuffs.
3. Stabilization of conditions and acceleration of speed in introductory stages of the dyeing process.
4. Simplification in cost accounting.
5. More rigid control over dyeing operations, and a definite basis for estimate and planning work.
6. Establishment of a uniform, reliable basis of specification for purchase of materials and of survey of plant facilities (and acquainting the trade with same) for production of new seasonal colors demanded.
7. Simplification in operation and consequent reduction in manufacturing cost.
8. Improvement in quality, stability and reliability of product, creating a good-will asset for increasing sales.

The Making of Colored Papers

Similarity Between Paper and Textile Coloring—Mineral Substances and Color Lakes—Hydration of Cellulose in Relation to Absorption—Beating of Stock—Sizing of Paper—Results of Beating Test—Testing Filter Quartz—Aniline Dyes for Paper Dyeing—A Hint to Dye Demonstrators—The Beating Process—Advantages of Mineral Colors—Conclusion

By MARTIN L. GRIFFIN

THERE have been so many contributors of late to some phase of this subject that I hesitate to enter the field. My only claim to any special attention at this time is the fact that I have been for many years a technologist for both the paper and textile finishing industries. They are not usually regarded as having much in common, but in reality have many similar characteristics. We cannot think of colored fabrics in any other language than that of dyestuffs and dyeing, and this art is very old and involves much knowledge and long experience. A good dyer must have color sense to a very nice degree, and such a dyer will be more valuable than a more technically educated man without this special sense.

In paper making it is usual to speak of colored and tinted papers, but seldom as dyed papers. The phrase "dyed in the wool," which means the last word in fastness of colors in the textile industry, has never been used in connection with paper. This is natural enough, because paper is relatively ephemeral. One could not expect that the art of dyeing would have such a wide application to paper, whose chief use is to form a white background for printer's ink for most reading matter.

The dyer is concerned with dyes and their application only. The paper maker must have a practical knowledge of his raw materials, their preliminary treatment, the refining of the half-stuff, the formation

of the sheet and the final finishing processes. This is a very comprehensive responsibility to assume. If there are colored papers to make he must be responsible for them.

So it comes about that the paper maker has not acquired the art of dyeing that is so essential to the textile industry.

The principles of dyeing applicable to cotton fabrics are applicable to paper. Paper is made from cotton rags or cellulose, which is chemically the same. The same general method of bleaching the stock preparatory to dyeing or coloring is practised. The applications of dyes ought, therefore, to have many similar characteristics, and it is some of these I propose to discuss in this contribution.

Textile finishing has many more limitations than paper making, and this is well illustrated in the application of colors. Cloth must be dyed if it is to be colored, by which we are to understand the fixation of coloring matter on and in the fibers so that it will remain permanently and preferably fast to ordinary wear. Paper does not have to meet these specifications with one exception—it should be fast to light. Pigments and colored lakes are not adapted to dyeing, but they are pre-eminently adapted to the making of colored papers. Formerly a few mineral colors supplied the principal needs, of which ultramarine, chrome yellows, ochres and Prussian blue are good examples. These mineral substances, properly prepared, and colored lakes are very much superior, from a paper-making standpoint, to dyes.

They act as a filler and give a solidity to the color of the paper which cannot be had with dyes. I do not wish to be understood as precluding the use of the aniline dyes, with their great tinctorial power for coloring very cheap papers, or even their use, properly chosen, when fixed upon a suitable base for the better grades of book papers. They are, of course, indispensable for colored transparent papers. I will return to this phase of my subject later.

I wish now to consider the subject of hydration of cellulose as related to the absorption of coloring matters. It is well known to dyers and technical chemists that as long ago as 1844 John Mercer was searching for improvements in the fixation of dyes in cotton dyeing and he discovered that when cotton fabrics were saturated with strong caustic soda solutions a marked physico-chemical addition of water took place, known as hydration, and an increased absorptive capacity for many dyestuffs. To-day this fact is widely recognized in the dyeing of cotton textiles. A much richer and deeper shade is produced by this treatment. Cloth well bottomed and mercerized is now dyed in continuous machines with no accessories. Any degree of hydration is beneficial.

It so happens that the paper manufacturer who wishes to make colored papers can benefit by this knowledge and take a profitable lesson from the textile dyer.

All wet processing of paper stock tends toward hydration in some degree. It is particularly noticeable in the washing of soda pulp after blowing from the digesters. The process of beating stock performs several important functions. The inexperienced person looks upon beating as a process of "chopping up" the fibers so a sheet can be formed. The beaterman thinks of it as a process of "drawing out" the fibers, and knows how to adjust his roll to produce the results required for the kind of paper to be made. He knows that as the beating and "brushing" process proceeds the pulp becomes more slippery and plastic, and tends to withhold water. Dragging viscoscimeters are designed to show the progress of beating by measuring this slipperiness. The degree to which this quality is carried is a measure of "freeness," so called, when bulky opaque papers are to be made, which are relatively weak in strength, and "slowness," wherein the stock is beaten much longer, tending to qualities of transparency, hardness and increased strength as in bond papers. It is just a matter of degree to which the process is carried.

In other words, the mercerizing process in the textile finishing industry and beating in the paper engine are essentially similar in the matter of hydration. Each is producing an incipient colloidal conditioning of the fibers, whereby they are more reactive chemically and physically.

The sizing of paper is a good example of this combined reaction. Cellulose is a weak base and will combine to a degree with acids and with those metallic bases which under certain circumstances reveal their acid characteristics. So it happens that in sizing paper pulp with a rosin soap and alum we get an actual chemical and physical union of the rosin with the cellulose and the alumina. Free rosin is not as effective in sizing, though it is water-repellent. All the metals of the metallic salts used in the dyehouse for dyeing have acid characteristics, if you will scan the list. These same metallic salts are the only ones which will effectually size paper. The obvious reason is they will react with sensitive basic cellulose. In other words, they form colorless lakes *in situ*, if you wish to picture the process to your mind's eye in this fashion.

Therefore, if one wishes to get the best results in paper making, either in sizing or the application of color, he should beat or hydrate his stock to that most sensitive reactive condition, consistent with the class of paper he wishes to make, before the addition of either size or color, and the size and color should be well diffused while the stock is in the dispersed phase before the mordanting treatment with alum.

Julius Huebner, in a paper read before a conference of paper makers in Edinburgh September 26, 1923, de-

tailed the effects of beating purified cotton yarn for varying lengths of time, upon its capacity to absorb night blue, and found that the time of beating influenced the degree and rate of absorption of this color to a marked degree. In explanation he says: "This is no doubt due to the larger amount of fibrous surface exposed by the disintegrated fibers to the dye bath." To prove this he took equal weights of artificial silk composed of filaments of different diameters, also two grades of emery powder, and subjected them to a dyeing process, and, finding more dye attached or associated with the silk of smaller diameter and the finer emery powder, he concludes that he is right in his deduction. Beating might, therefore, mean nothing more than the cutting up of the fibers, thus exposing a greater surface. In conclusion he say: "The effects upon dyestuffs absorption by prolonged beating and the degree of hydration of the fibers is at present still under investigation." Thus he progressively loses faith in his own experiments and is not clear in his own mind as to the function of beating and its relation to dyeing.

A year or two ago I constructed two filters for filtering mercerizing washings, using a certain grade of pure crushed quartz as the filtering medium. After a time I had a feeling that the filters were doing better work than when they were new, and I reasoned that probably the caustic had produced an incipient gelatinous film of silicate upon the grains of quartz which intercepted some coloring matter. I proceeded to dye a small quantity of this well-washed quartz alongside a sample of the new with Methylene Blue, and found that the quartz exposed to the action of the caustic would dye to a fairly deep shade, while the new retained no dye. There can be no doubt as to the mechanism of dyeing in this particular case, and this knowledge has several useful applications. When one stops to review the extensive field where colloidal matter intercepts, collects and clarifies, we may get some idea of its importance. We know we cannot bleach, wash or rinse pulp in a paper mill or cloth in a bleach house and retain a bright white shade if the water supply is not colorless. Therefore, if we apply this knowledge to dyeing and coloring paper it will point the way to advancement.

All paper stocks cannot be treated alike for the obvious reason that all papers are not alike. The stock for newsprint paper gets little or no beating, just a mixing; while bond and glassine are hydrated by beating to the point of transparency. There is no trouble to dye these papers deep shades. In the one case the stock is not at all receptive toward dye, while in the other it is made very receptive.

Notwithstanding what I have said about mineral colors and colored lakes, aniline dyes find a wide application in the manufacture of colored papers. Therefore, some definite things should be said about them.

First—Only those dyes should be chosen which are fast to light, even those which are to be short-lived, so far as possible.

Second—Only substantive dyes should be selected, and there is a good range of this class of colors.

The use of aniline dyes in the paper mill suffers one important handicap in comparison with textile dyeings, in that they are applied at elevated temperatures which are not practicable in the paper mill. Neither can paper stock be dyed by degrees till the shade is right, as in jig dyeing. The color must be added all at once as a part of the furnish. If the color is insoluble, as Ultramarine, the paper maker can depend upon a uniform shade even though conditions may vary somewhat. If, however, a dye is used which is soluble and has little affinity for the stock, and if the machine tender must rely upon the use of his back water to hold his shade and prevent the loss of color, he can have no assurance that his shade will be uniform.

Dye demonstrators should acquaint themselves with the essential features of paper mill processes and make their recommendation from the viewpoint of paper making rather than textile finishing, which they are very prone to do. They should study the mechanism of the beater furnish and the beating process, and how this process advances and under what conditions the results can be best attained. It should be carried out in a neutral or slightly alkaline condition, in the dispersed phase. Clay starch and size may be added early. In this phase clay will be dispersed and have less tendency to settle in any part of the process. Until the stock is properly beaten coloring matter and alum should be kept out.

When the beating is nearly or quite finished, the roll should be lifted, the coloring matter furnished and well incorporated into the plastic pulp, and, finally, the necessary alum added to properly size it. Tannic acid, alum or any acids or acid salts should not be introduced during the beating. The recommendation of soda ash in any amount and the consequent larger use of alum is only an attempt to introduce a mineral colloid for the better fixation of the color. So far as such a procedure is proper, the object can be obtained more efficiently by substituting sodium silicate for soda ash.

Thus, the mechanism of dye fixation, adsorption or mordanting—call it what you will—includes an intermediate substance which has some kind of bond, possibly chemical as well as physical, or colloidal, if you please, for the dye and the material to be dyed. Regarding a mordant as a colloid which adsorbs the color, if we are able to produce a colloidal condition of the material to be dyed we can dye it without an external mordant. This is the fact with mercerized cotton, quartz exposed for a considerable time to the action of caustic soda solutions, and well-beaten pulp.

In conclusion, I wish to emphasize what I have said about mineral colors and their advantages generally in

giving solidity to the color effect, aiding as a filler to make the paper more opaque, to the fact that they are easily handled, do not bleed, require no special preparation and no dyer's technique, that color matching is much simplified and two-sidedness reduced to a minimum. In view of these advantages, I believe there is a real place in the paper industry for a mineralized line of the best aniline colors. This, I feel, is a very important and practical suggestion, and well worth the serious attention of the dye-making industry. By a suitable combination of china clay, sodium silicate and alum, mineralized coal-tar colors can be made carrying upward of 10 per cent color, which if ground to a fine powder will have a good covering capacity. Such lakes are well known to the textile printing trade.

Summing up the essential points of my argument—

First—The paper industry has no place for the dyer's technique. Dyeing processes as applied in textile finishing are not well adapted to paper.

Second—Dyeing of cellulose is fundamentally involved with a reactive adsorbent environment induced by hydration, and (or) aided by assistants—mordants, so called.

Third—This environment should be created so far as possible by process means, mercerizing in textiles and beating in paper, in a dispersing medium.

Fourth—Of the coal-tar dyes, the substantive should generally be chosen on account of their fastness to light and their affinity for cellulose without assistants.

Fifth—More attention and research should be devoted to the mineralizing of aniline colors for the paper trade.

Dyeing Cotton Piece Goods with Hydron Blue

Sulphur Dyestuffs and Indigo—Piece Dyeing of Fabrics—Introduction of the Hydron Blue Colors—Dyeing with Hydron Blue—Conditions of Dyeing Process—Composition of the Dye Bath

(Translated from Deutsche Faerber Zeitung by Ismar Ginsberg)

BEFORE the introduction of the vat dyestuffs it was impossible to obtain a blue color on fabrics which was actually resistant to the effects of boiling, washing, acids, chlorine and light unless indigo was employed as the coloring matter. While one or more properties of fastness were possessed by fabrics which had been colored with benzidine or sulfin dyestuffs, nevertheless, only those fabrics which had been dyed with indigo exhibited the desired degree of fastness to all influences which tend to destroy color according to the practical observations that were made with indigo-dyed fabrics in every-day use. For example, a pair of overalls used by a workman and covered with oil spots was boiled several times and thoroughly washed to remove the stains, and still the blue cloth appeared a clear blue, although somewhat lighter in shade, even when chlorine was used in the washing process. All other substitute dyestuffs gave under the same conditions a grayish colored fabric, and as the garment was used this gray became more and more distinct.

Sulphur Dyestuffs and Indigo

Right from the start the sulphur dyestuffs were competitors of the indigoes. Certain representatives of the former class of dyestuffs were known to be fast to washing and possessed bright and moderately dull shades. However, in spite of the simple dyeing process these dyestuffs were unable to displace the indigo because of the latter's very advantageous properties in the production of deep blue colored fabrics.

Piece Dyeing of Fabrics

As in the dyeing of cotton piece goods it was possible to attain a very much greater production of colored fabrics than when dyeing in the indigo vat, and furthermore, as the fabrics that were dyed in this manner all possessed more uniform color, it was found to be more preferable to employ the piece dyeing method rather than the yarn dyeing method for dyeing many kinds of fabrics. Nevertheless, there was lacking a substance which was stable and which did not produce foam, as the use of sodium bi-sulphite as a reducing agent had this disadvantage. It was first possible when stable hydrosulphite products were introduced into practical dyeing operations—such hydrosulphites as sodium hydrosulphite in concentrated solutions—to abandon the practice of making a rapid change of the dye bath and employ in its place the continuous dyeing process.

However, it was still impossible to obtain a deep average dark, and dark blue on the fabrics in one passage through the dye bath. It was necessary to pass the goods through the liquor several times, and each time allow the air to act on it so that the indigo white was completely oxidized to the blue variation of the dyestuffs. This was particularly necessary in order to dye the goods through and through with a uniform blue shade of proper in-

tensity. This necessitated the use of rather complicated apparatus, and the application of various systems of guide rollers and the like to guide the goods during its passage through the air to effect the oxidation of the indigo white. The erection of such devices over the dye baths is obviously inconvenient, but it was necessary to have such an installation in order to obtain a properly dyed fabric.

Introduction of the Hydron Blue Colors

The introduction of the different dyestuffs of the hydron blue series into practical dyeing operations fulfilled a need which had been puzzling the textile dyers for many years. For it was possible to obtain a dark blue with these dyestuffs by one passage of the goods through the dye liquor. Although the color tone of the fabrics dyed in this manner with the hydron blue colors is a little clearer and of a more violet tinge than the goods dyed with indigo; nevertheless, in most cases this condition was not of any great importance. One reason why this result was not of any significance was that the fastness of the color was considerably greater than that of indigo, and, furthermore, it was possible to shade the color by means of hydron black blue and so remove the violet tinge in the dyed fabrics.

The last named dyestuff does not possess the great fastness to chlorine that is characteristic of hydron blue, a fastness which is much superior to that of indigo, but for most purposes it is fast enough from this standpoint, and at any rate it was far superior to the best grade of sulphur blue. Then again, it was possible to shade the blue by means of the dyestuff, hydron yellow, which is mixed with the hydron blue. However, as a general rule, the pure blue dyestuff, hydron blue, was found to give the best results of all.

Dyeing with Hydron Blue

In dyeing textile fabrics with these new products it is necessary to use a special device for piece goods. This device is often used in dyeing piece goods with sulphur blues and is far simpler than that necessary in dyeing the materials with indigo. The color jigger must be provided with a squeeze roller which is advantageously covered with rubber and fitted with a device for raising and lowering the roll and thereby increasing or decreasing the pressure exerted by it. Besides this there is required an oxidizing arrangement whereby the dyed goods can be subjected to the action of air. This generally consists of a series of wooden rollers which are set up over the jigger. It is not necessary to squeeze the dye out of the cloth each time that it passes through the dye bath. It is only as the cloth leaves the dye liquor after the fifth passage through the bath that the squeeze roller is lowered.

At this time the first part of the cloth is pulled through between the squeeze rollers, and the pressure of the rollers is properly regulated. Then the cloth is subjected to this pressure and passed through the jigger for the last time. Following this it is squeezed between rollers so arranged as to exert the same pressure all over the width of the goods, run over the wooden guide rollers over the dye bath and then folded together by means of a mechanical device. It is advisable to allow the goods to lie for from a quarter to a half an hour; nevertheless, the color on the material oxidizes during the time that it is being washed and completely dried.

Conditions of the Dyeing Process

When the goods leave the dye liquor they must be colored a light yellow, otherwise they are apt to be spotted with dark-colored spots. As soon as the dye liquor turns blue in color, more hydrosulphite must be added. Later, when the sodium hydrosulphite dyeing process was introduced, the competitive conditions between hydron blue and indigo were materially improved to the advantage of the former. In order to obtain a production of dyeing fabrics in as great quantities as possible, the goods are washed quickly in the jigger, which is situated in a bath of the one that is used directly in the dyeing process, and then the dye bath is immediately brought back to the original concentration by the addition of from half to two-thirds of its weight of coloring matter.

The dyeing process is begun at the boiling temperature, but when the goods are introduced the steam must be turned off. After the goods have passed through the dye bath three successive times, the liquor is cooled down to 70 deg. Cent., and there is added to the bath which contains at the outset the proper amounts of both sodium sulphide and Glauber salt the necessary proportion of sodium hydrosulphite. The action of this material is immediately manifested by the change of the color of the bath and of the goods as well from a green to a yellow. This change is complete and takes place rapidly.

The goods, after being passed through the color bath for the second or third time, are squeezed between squeeze rollers, and subjected to the regular treatment. However, before the excess dye is pressed out of the fabric, the color must be brought to shade each time, as in the dyeing process in a stationary dye bath, especially when direct steam is used for heating the bath slight differences can take place in the various shades that are produced on the fabrics.

In certain cases where the process is carried out in a practical manner the results are very satisfactory, as in one day from four to five pieces of goods, weighing from 10 to 11 kilograms, can be conveniently dyed when the apparatus is working well. But this is the case only where there is present in the factory a good machinist who knows how to operate the machine. It is generally more important to have such a man than a good dyer, and this operator must know how to sew the pieces of goods together without waiting for someone to do this for him. One of the occurrences that are known to de-

(*Continued on page* 146)

Proceedings of the American Association of Textile Chemists and Colorists

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COLOR MEASUREMENT*

By LOYD A. JONES

During the past few years there has been a constantly increasing demand from the industries for a satisfactory method of measuring and specifying color. This seems to arise from an awakening to the necessity or desirability of measuring and standardizing the colors of raw materials as well as the finished products in order that reproductibility and constancy of this characteristic may be maintained. As typical classes of materials for which color measurement is being demanded may be mentioned paints, varnishes, dyes, textiles, paper, leather, oils, etc. From the present indication it is safe to predict that within the next few years the science of colorimetry will develop into one of the important branches of applied optics.

The entire field of color measurement and specification has been in a rather chaotic condition, due largely to the lack of a satisfactory system of color nomenclature and to the absence of agreement as to the definition of words used in expressing color characteristics. Further, no really satisfactory and practical instruments have been available for the measurement of color.

Increasing interest has been manifested in the development of a more satisfactory nomenclature for this field of science, and the Optical Society of America has appointed a committee to deal with this subject. This committee has presented several reports, and recently a rather long and carefully prepared report was published in the journal of the organization. This report probably represents the most satisfactory work that has been done on this subject and, while certain of its recommendations are still subject to discussion, there is no doubt that a careful study of the report will be very valuable to those interested in the subject. In the following paragraphs are given verbatim some of the definitions and recommendations made in this report, and in the following discussion an effort will be made to use the words according to the definitions of this report. The author wishes to take this occasion to urge all of those interested in the question of color measurement and specifications to give this report their earnest attention and in so far as possible to adopt the definitions and nomenclature suggested therein. There is no doubt that the mutual agreement among workers in this field to use a uniform system of nomenclature will add materially in clarifying the situation and result in more rapid progress.

EXTRACTS FROM THE REPORT OF THE COLORIMETER COMMITTEE, OPTICAL SOCIETY OF AMERICA

"A. *Color.*—Color is the general name for all sensations arising from the activity of the retina of the eye and its attached nervous mechanisms, this activity being, in nearly every case in the normal individual, a specific response to radiant energy of certain wave lengths and intensities. It may be exemplified by an enumeration of characteristic instances, such as red, yellow, blue, black, white, gray, pink, etc.

*Delivered before the Rhode Island Section of the American Association of Textile Chemists and Colorists, November 23, 1923.

"It is impossible to identify color with radiant energy or with wave lengths of radiant energy, although radiant energy is the adequate stimulus for color. This is because color is known to depend upon the presence and character of the perceiving individual and because it is directly recognized to be something radically different in kind from its stimuli. Consequently, nothing but confusion can result from the use of the word 'color' as a synonym of 'wave length constitution.' Color cannot be identified with or reduced to terms of any purely physical conception; it is fundamentally a psychological category.

"B. *The Three Attributes of Color.*—The nature of any color can be completely specified psychologically in terms of three fundamental attributes, this specification taking the form of an immediate description of the color, as such, *without any reference whatsoever to the stimulus.* The names employed for these three attributes by different authorities vary widely and frequently are such as to refer not only to properties of the color but also to related properties of the stimulus. Hence it seems necessary, in the interests of unambiguous thinking, to introduce certain refinements and possibly some innovations in terminology at this point. The Committee suggests the following nomenclature:

"(a) *Brilliance* is that attribute of color which allows it to be classed as equivalent to some member of a series of *grays* ranging between black and white. Synonymous terms, as used by various writers, are 'luminosity' (Abney, 4, 4, 86) (Rood, 89, 33) (Troland, 93, 948), 'brightness' (Luckiesh, 55, 1) (Helmholtz, 21, 243-245), 'tint' (Titchener, 92, 61-64), 'value' (Munsell, 57, 12-13), and 'visual brightness' (Nutting, 63, 300).

"(b) *Hue* is that attribute of certain colors in respect of which they differ *characteristically* from the gray of the same brilliance and which permits them to be classed as reddish, yellowish, greenish or bluish. There is a very satisfactory agreement among authorities regarding the usage of this term, which seems not to have been corrupted by any definite physical application.

"(c) *Saturation* is that attribute of all colors possessing a hue, which determines their *degree* of difference from a gray of the same brilliance. Synonymous terms, as used by various writers, are 'purity' (Rood, 89, 32; Nutting, 67, 139; Abney, 4, 4) and 'chroma' (Munsell, 61, 12-14; Titchener, 92, 62-63).

"(d) Auxiliary Terms: The term *chromaticity* may be used to characterize a color qualitatively without reference to its brilliance. Chromaticity is determined by hue and saturation together, a gray being specified by the statement that it has *no* chromaticity.

"(e) Interdependence of the Attributes: All colors except absolute black exhibit brilliance, but grays have zero saturation, and hence no hue. All colors which exhibit a hue must also exhibit saturation, and *vice versa.*

"C. *Species of Colors.*—Colors can be classified into *chromatic* and *achromatic* species, according as they do or do not exhibit hue, respectively. The former may be designated briefly as *chromas* (including colors of all degrees of saturation) and the latter as *grays* (including black and white).

"*Median gray* (= 'mid-gray') is the middle member of a series of grays in which each member differs from its immediate neighbors by the least perceptible difference, and of which black and white are the terminal members. This gray furnishes the most practicable reference point for the achromatic as well as for the chromatic series of colors.

"*Median colors* are all colors equivalent in brilliance to median gray, including the latter.

"*Tints and shades* are colors, including grays and chromas, which are respectively lighter or darker than median gray.

"D. *Psychological Primaries.*—The psychologically primary colors are those which are necessary and sufficient, in minimum number, for the description of all colors by introspective analysis. For normal vision these primaries are: black, white, red, yellow, green and blue (73, 251-252; 94, 21). Red and yellow may be grouped together under the designation of 'warm,' while green and blue may be classified under the designation of 'cold' primary chromas.

"E. *The Measurement of Color.*—The three attributes of color can be treated as quantities and specified numerically if all discriminable colors are conceived to be arranged into a system such that neighboring members differ from one another in each of the three attributes by just noticeable degrees (or threshold steps) (92, 207-215; 13, 1-10). Such a system (*vide infra*) is necessarily three dimensional (61, 18-31), and three ordinal values, representing the positions of a given color in the several dimensions, are needed to define the color. The spectral chroma scale, considered more in detail below, is an application of this principle of color measurement to the study of the dependency of chromaticity upon wave length.

2. Stimulus Terms

"A. *Radiant Energy.*—The adequate stimulus of color consists of radiant energy of certain frequencies or wave lengths which have various stimulus values, depending on the type of visual response system under consideration. The term 'radiation' is often employed as a brief equivalent of 'radiant energy,' although this usage tends to confuse the *process* of radiation with the outcome of the process.

"B.—The *Physical Spectrum* is an arrangement of radiant energies in order of their respective frequencies or wave lengths. It should not be confused with the *color*

spectrum, which is a series of colors aroused by part of the physical spectrum.

"C. *Spectral Distributions.*—The properties inherent in any sample of radiant energy which determine its capacity as a color stimulus are completely specified by its *spectral distribution,* which expresses the 'intensity' of any frequency (or wave length) as a function of the frequency (or wave length) in question.

"(a) When plotted in the form of a curve, the *ordinates* of a spectral distribution represent 'intensity' per abscissa unit (frequence or wave length, as the case may be); and the intensity concept, for the essential case of the incidence of the radiant energy upon the retina, will be energy per second per unit area. To be completely specific, the function must express absolute values, but this is often difficult in practice.

"(b) The *wave length unit* which is ordinarily employed in colorimetrics in the milli-micron, which is correctly symbolized by mμ (not μμ).

"(c) It is to be noted that wave length, strictly interpreted, does not furnish a reliable specification of the color-stimulating capacities of radiant energy, as the response of the visual systems depends upon *frequency,* while wave length may vary independently of frequency. Since wave lengths can only be interpreted in colorimetrics as reciprocal representations of frequency, it would be desirable theoretically to employ frequency directly in formulating spectral distributions. A suggested unit of frequency is the *fresnel,* defined as one vibration per trillionth (10-12) of a second. Table 1 provides means for interconverting between milli-microns and fresnels.

"(d) Spectral distributions of *transmission, reflection, luminosity,* etc., which are often employed to specify 'color,' may be regarded as constituents or as developments of the essential distribution function (*vide infra*).

"D.—*Homogeneous radiant energy*—for the purpose of colorimetrics—is radiant energy, sensibly all of the intensity of which lies within a single spectral region so small as to exhibit—under the conditions most favorable for discrimination—no perceptible hue difference within the region.

"E.—The color which is evoked by any adequate stimulus depends not only upon the spectral distribution of the latter but also upon certain further conditions which may be called those of its *mode of incidence.* These conditions include: (1) The type of color system possessed by the observer; (2) the portion of the retinal field stimulated; (3) the size of the field; (4) the momentary state of adaptation of the optic nervous mechanism, and (5) the exitation processes in adjacent visual areas. In accurate work these factors require specification. In general, we assume pure cone vision of the normal trichromatic system, central fixation, a size not exceeding three degrees, and a gray contrast field of the same apparent brightness as the given stimulus light (*vide infra,* for conditions of pure cone vision)."

It should be noted that these definitions carefully distinguish between objective and subjective factors. Color is defined as a sensation (subjective) resulting from the action of a stimulus (objective) which in most cases is radiant energy. If this definition be adopted (and this seems to be the only logical course) it is evident that a satisfactory measurement of color must be based upon measurements (either direct or indirect) of the three attributes—hue, saturation and brilliance.

Radiant energy which may be measured by purely physical means is the cause or stimulus of the sensation of light. The quality of the radiation may be specified physically by stating its wave length in case radiation of but one frequency is present or in case it is composed of a mixture of many frequencies by stating the wave length and intensity of each of the component parts. A curve representing the relation existing between the intensity and wave length of such radiation constitutes a complete physical specification of the quality of the radiation. The retina, however, being a synthetic rather than an analytic receiving organ, does not recognize individual component parts of radiation as such, but interprets the mixed radiation as a single stimulus producing a unitary sensation. Hence, a spectrophotometric curve showing the spectral distribution of energy, while entirely satisfactory from a physical or objective standpoint, does not constitute a specification of the color. It is evident from this brief consideration that the subject as a whole may be said to consist of two phases, one concerned with the measurement and specification of the stimulus—that is, radiant energy—from the physical standpoint, the other dealing with the measurement and specification of the sensation resulting from the action of the stimulus on the retina.

We will briefly consider what may be termed the objective phase of the subject and the methods employed for measuring the quality and intensity of radiation. This is most satisfactorily accomplished by separating radiation into its component parts and measuring the intensity of the individual elements. This intensity factor is properly expressed in watts (or ergs per second) per unit area of the source per unit difference in wave length. These values when plotted as ordinates against the various wave lengths as abscissae result in the graphic representation of the spectral energy distribution for the radiation considered, which is commonly referred to as the spectral energy curve. These measurements are made by means of an instrument known as the spectroradiometer, in which either a bolometer or thermopile is employed as the receiving elements, and are, therefore, independent of the retina. In Fig. 1 is shown such a curve determined for the cylindrical acetylene flame.

The precise determination of such a curve requires

elaborate equipment and considerable experience in manipulation on the part of the operator. However, if this function is known for one source that of any other can be determined indirectly with considerable ease by methods of spectrophotometry. The methods consist simply of the separation and quantitative measurement, wave length by wave length, of the intensity of the unknown radiation in terms of that of the known thoroughout the visible range.

Non-luminous objects are visible only by virtue of the

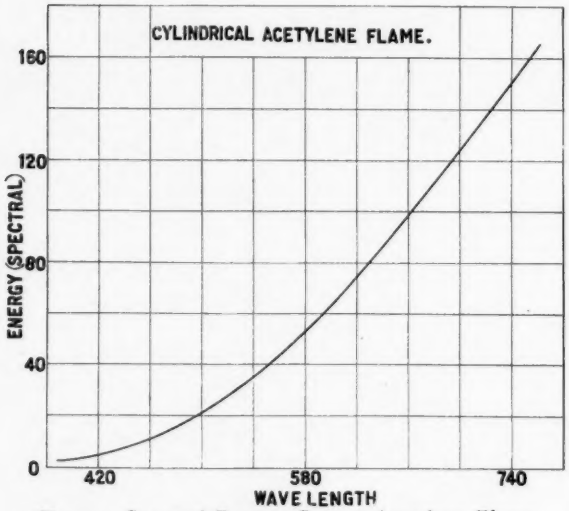

FIG. 1—*Spectral Energy Curve, Acetylene Flame*

radiant energy which they transmit, reflect or otherwise divert in such a way that it enters the eye and falls upon the retina. In case an object reflects or transmits to an equal extent all wave lengths of the incident energy within the visible range it is said to be achromatic or non-selective. However, when an object transmits or reflects to an unequal extent the various wave lengths of the incident energy, it is said to be chromatic or selective, and the chromaticity depends upon the relative amounts of the various wave lengths absorbed. This selective absorption may also be specified by means of spectrophotometric curves in which are plotted values of transmission or reflection as ordinates against the wave length values as abscissae.

Typical spectrophotometric curves are shown in Fig. 2. These apply to a solution of a scarlet dye made up to concentration of one in 15,000 and examined in a layer 1 cm. thick. Curve "a" is plotted in terms of percentage transmission as shown by the ordinate scale at the right of the figure. It will be noted that the transmission is a minimum (3 per cent) at wave length 510 mμ. The transmission increases for both shorter and longer wave lengths, rising to a maximum at approximately 600 mμ, where it becomes 77 per cent. The curve from this point on to 700 mμ (the limit of the visible) is a straight line, and through this region the solution under the specified condition transmits 77 per cent of the radiation. This solution observed visually appears a brilliant scarlet. The transmission at the blue end of the spectrum (400 and 500 mμ) is relatively unimportant in determining the color, since the visibility of radiation in that region is relatively low.

For many purposes it is more convenient and useful to express the spectrophotometric characteristics of a dye solution by means of the density curve (curve b, Fig. 2). Density in this sense is defined as the logarithm of the reciprocal transmission, transmission in this case being expressed decimally rather than as a percentage:

$$D = \text{Log} \frac{1}{T}$$

The ordinate scale for the density curve is shown at the left of the figure. It will be noted that the maximum of the density curve occurs at the same wave length as the minimum of the transmission curve. The ordinates of the density curve are proportional to the absorption, hence a maximum of the density curve indicates a maximum of the absorption. The density values, being expressed in a logarithmic form, are additive and subtractive in nature, and in order to obtain the resultant density curve of two or more dyes it is only necessary to add the density values, wave length by wave length. Such spectrophotometric curves are very valuable in the identification of coloring materials, since the position of the maximum and minimum and the general shape of the curves are characteristic

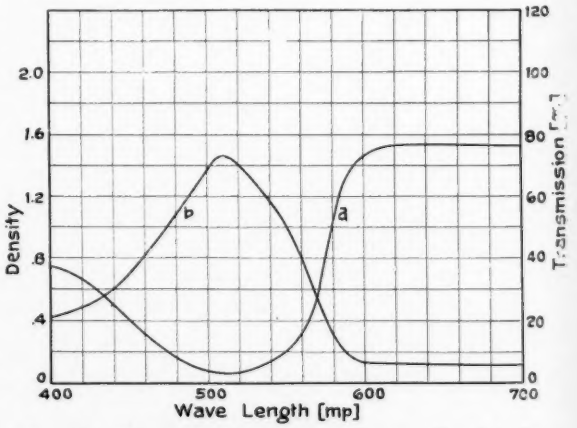

FIG. 2—*Spectral Photometric Curve, Scarlet Dye —(a) Transmission; (b) Density*

of the chemical bodies present in the dye. They are also very useful in determining the purity of a given dye. Thus, if two samples of the same dye are made up to the same concentration (by weight), the ratio of the ordinates may be taken as indicative of the relative purity of the two samples. In order to obtain solutions of identical effective dye concentration it is only necessary to increase the concentration of the less pure sample in the proportion to the ratio of the ordinates at any given wave length. It is customary for this purpose to use an ordinate at the maximum absorption, since this ratio can, in general, be determined with somewhat greater precision than at a point in the spectrum where the density is relatively low. Spectrophotometric curves are, therefore, very useful for certain purposes, but they do not in themselves give a direct specification of color. It is theoretically possible, by the use of proper conversion formulae, to reduce these data in such a way as to obtain a specification of color. At the present time, it is questionable whether this can be done with as great a precision as can be obtained by a direct measurement of color. Extensive research is now in progress on this subject, and it is probable in the near future that conversions from spectrophotometric data to color can be made with thoroughly satisfactory results. It should be emphasized, however, that the spectrophotometer does not measure color but analyzes the stimulus into its component parts.

The measurement of color involves the specification of its three attributes—hue, saturation and brilliance. In order to establish satisfactory scales by means of which the relations between various colors may be logically expressed, it is necessary to know the relation between the various attributes of color and the physical stimuli. Just as in the case of a physical instrument, such as an ammeter, where it is necessary to know the relation between the stimulus (the current flowing) and the response (the deflection of the needle) in order to obtain a measurement of the current strength, so in the case of the eye it is necessary to know the relation between the stimulus and the response (sensation) if a satisfactory specification is to be obtained.

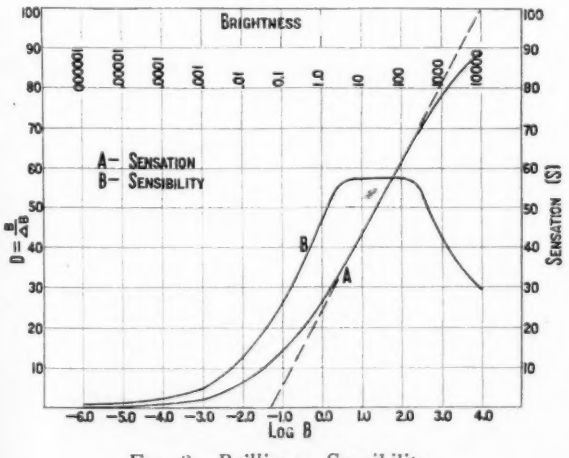

FIG. 3—*Brilliance Sensibility*

The three fundamental visual sensation functions

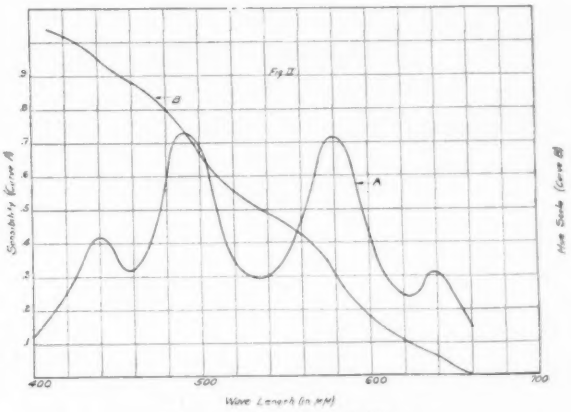

FIG. 4—*Hue Sensibility*

upon which a logical system of quantitative color specifications must be based may be referred to as:

(a) Sensibility to brilliance difference (brilliance scale).

(b) Sensibility to hue difference (hue scale).

(c) Sensibility to saturation difference (saturation scale).

The only unit in which sensation is expressible is that of the least perceptible difference, and the scales mentioned above must be built up with the least perceptible difference as the fundamental unit of the scale.

Careful work has been done on the determination of the brilliance scale, and very satisfactory and reliable data are available from which this scale may be constructed. In Fig. 3 the curve "b" represents the sensibility to brightness differences, while curve "a," which is the integral of curve "b," becomes the sensation curve and gives the required relation between brightness and sensation. If now equal intervals on the sensation scale (shown at the right of the figure) be laid off and projected across to curve "a" and down to the axis of log "b," the values of stimuli (brightness) thus obtained are those which will result in equal brilliance (sensation) steps.

Some fairly reliable data relative to the hue scale are available, and in Fig. 4 the curve "a" represents

the visual sensibility to hue difference. By the intergradation of curve "a" the curve "b" is obtained, which is the sensation or scale reading curve and gives the desired relations between the wave length of the stimulating radiation and the desired hue scale. The construction of the desired hue scale is the same as in the case of the brightness scale. Equal intervals on the hue scale axis (at the right of the figure) projected onto curve "b" and down to the wave length axis gives

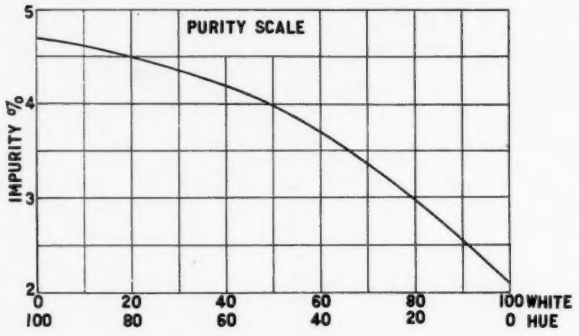

FIG. 5—*Saturation Sensibility*

the wave length separation of the stimuli which result in equal steps on the hue (sensation) scale.

Very little work has been done in establishing the saturation scale. A few data are available, however, which indicate the general type of this function. A qualitative idea of this is given by the curve in Fig. 5, where the just perceptible impurity (expressed as a percentage) is shown as a function of the saturation. This curve is based on rather meager experimental work, and much further work should be done in order to establish a more reliable saturation scale for use in the construction of a rational system of color terminology.

In order to measure color in terms of its three attributes, it is necessary to adopt methods which are synthetic in character rather than analytical, as in the case of spectrophotometric measurements. It has been demonstrated experimentally that any color can be matched by a mixture in the proper proportions of white light with homogenous radiant energy (commonly referred to as monochromatic light) of the proper wave length, and in this way a direct measurement of the fundamental sensation factors of color may be obtained. The hue is specified by the dominant wave length, which is the wave length of homogenous radiation used in obtaining color match. The saturation is specified either in terms of the per cent hue or per cent white, the value being obtained from the relative values of the intensity of white light and that of the homogenous radiation. The brilliance factor is specified in terms of the sum of the two intensities. This procedure can be applied only to colors possessing spectral hues, and in the case of the purples, which are mixtures of red and blue in various proportions, it is necessary to change the procedure somewhat and to obtain a match by mixing homogenous radiation with the unknown color until a match is obtained between this mixture and the standard white light. It is obvious that in this case the hue factor must be specified as the dominant wave length of the complementary. With this modification the method is capable of dealing with all possible colors, and is the only method available by which the three attributes of color may be directly measured. Instruments have been constructed working on this principle, of which the best is probably that devised by Dr. Nutting and constructed by Adam Hilger, of London. In Fig. 6 is a diagram which shows the arrangement of the optical parts of this instrument. Homogenous radiation is obtained by means of the constant device dispersing prism "P." Its position is controlled by the wave length drum "D," and from the scale engraved thereon it is possible at any time to read the wave length of radiation passing through the system and illuminating one part of the photometric cube "B." A source for this radiation is placed at "M," and is imaged by the condensers "L" on the slit "S." A pair of Nicol prisms at A_1 with a properly divided scale provides a means of varying the intensity at the will of the operator. White light from a suitable source, such as the sun, is reflected from the mirror "R" through the Nicols A_2 and, after passing through the lens O_2, is reflected from a mirror "M," and then illuminates the same portion of the photometric field as is illuminated by the homogenous radiation. The color to be measured is introduced through the Nicols A_2 and, after passing through the lens O_2, illuminates the other portion of the field of the photometric cube "B." The eye placed at "E," therefore, sees a two-part field, one of which is illuminated by the color under examination and the other by a mixture of white light with homogenous radiation. The intensities of all three components are under the control of the operator as well as the wave length of homogenous radiation. By proper adjustment an exact color match between the two portions of the field is obtained and the dominant wave length is read directly from the wave length drum "D." In order to determine the relative intensities of the white light and the homogenous radiation, it is necessary to use a flicker method. A flicker disk "M" is provided for this, and after the initial match is made this disk is started and a balance between the intensities of the white and homogenous radiation is obtained. From these values the saturation factor can be computed. The deter-

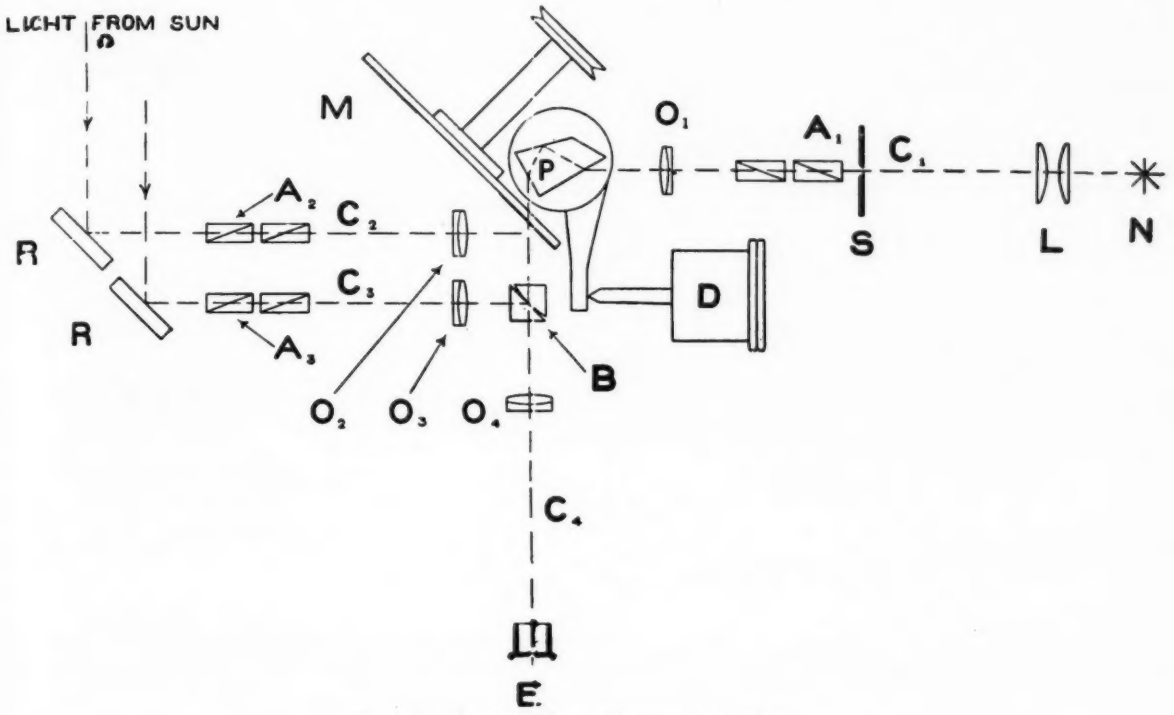

FIG. 6—*Nutting Mono-Chromatic Analyzer*

mination of the brilliance factor involves the use of a brightness standard which can be matched against either of the components of the mixture. This is not provided as an integral part of the instrument since for many purposes of color standardization it is only necessary to determine the hue and saturation factors. The number and type of optical parts involved in construction of this instrument make it somewhat difficult to adjust and to maintain in adjustment. In the hands of a trained physicist there is no doubt that the instrument will yield results of the highest quality, but it is questionable whether in its present form it is particularly applicable to production problems where the instrument may be in the hands of less skilled operators. It is evident that an instrument of this type must eventually be the reference standard for all color measurements, although its use may be confined to standardization laboratories, and instruments of other and more indirect types be used for routine work.

It is well known that any color can be built up by adding red, green and blue light in the proper proportions. Thus, if three projecting lanterns be placed side by side so as to illuminate the same white screen and if properly balanced red, green and blue filters be used, one placed in each of the three beams, the illumination on the screen will be white. Now, if the intensity of each beam is independently variable it is possible to build up by the additive process any desirable color. This color can then be specified in terms of the filters used and in terms of the intensities of the three beams. This principle is known as that of additive color mixture, and many instruments for the measurement of color by this method have been constructed and used. Some of these obtain the required red, green and blue light by the use of filters, and others have been constructed in which the desired red, green and blue are obtained by isolating certain definite regions of the spectrum. Three-color additive instruments of the spectral type are rather complicated and difficult to use. Such instruments have not, to the knowledge of the author, been utilized in practical work for the measurement of color. Other instruments of this type, due to structural peculiarities, lack portability and simplicity of operation. Difficulty is also encountered in obtaining red, green and blue filters of the required characteristics, and in some cases with the filters used difficulty has been encountered in obtaining a precise match with certain classes of colors.

Another method of obtaining a desired color is by the method frequently referred to as that of "subtractive mixture." This differs essentially from the method of additive mixture, in that but a single light source is used from which certain components are removed until that which remains matches the color to be measured.

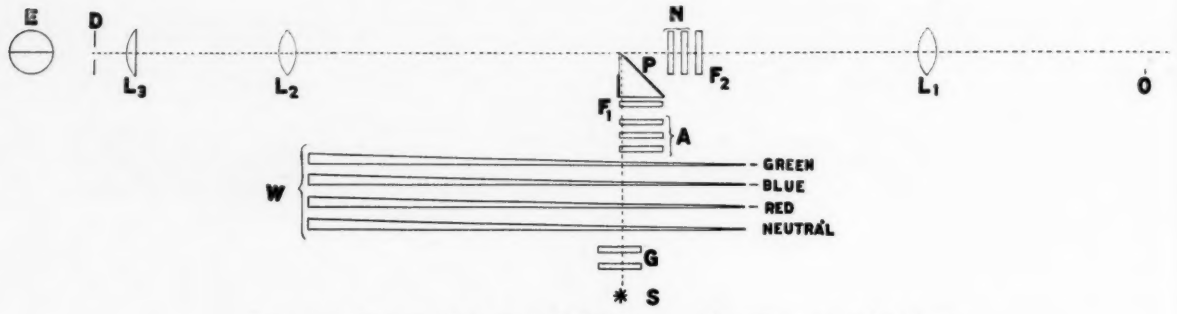

FIG. 7—*Eastman Universal Colorimeter: Diagram of Optical Parts*

It may be well at this point to explain more fully the meaning of the terms "additive mixture" and "subtractive mixture." While these terms have been used to a considerable extent, especially in connection with various processes of color photography, they may not be commonly understood. Perhaps the best way of explaining these terms is by the citation of concrete examples. Suppose, for instance, two projecting machines are mounted side by side and each illuminates the same screen surface. Now, in front of one of the projecting lenses let a green filter be placed, while before the other is placed a red filter. One projector acting alone would illuminate the screen with green light, while the other acting alone would illuminate the screen with red light. The two acting simultaneously result in a screen illumination which is yellow, and this may be taken as a typical example of the additive mixtures of red and green.

Now assume that only one projecting machine is used and both the red and green filters are placed in front of the projecting lens. The light which reaches the screen must pass through both filters, but since the green filter transmits no red light and the red filter transmits none of the light passed by the green filter. the screen is not illuminated and we may say that this subtractive mixture of red and green produces darkness or black.

In order to obtain a yellow screen illumination by the subtractive method, it is only necessary to place in front of the projecting lens a filter which absorbs the blue component of the sensibly white light emitted by the light source, the yellow in this case being obtained by the subtraction of the blue from the white light of the projecting beam. Suppose now that in front of the projecting lens of one of the lanterns is placed a blue-green filter and also a yellow filter. The screen will now be illuminated by green light, the red component originally present in the white light of the source being subtracted by the blue-green (that is, minus red) filter, while the blue component is subtracted by the yellow filter (that is, the minus blue), the resultant screen illumination being due to the light transmitted by both filters, this being the green component.

Thus, in the case of additive mixture the resulting color is built up by mixing lights of various colors, while in the case of the subtractive method the desired color is obtained by subtracting certain parts from the light used as a source of illumination. For a color-mixing device which is designed to match all possible colors by the additive method, a properly selected set of filters transmitting the primary colors—that is, red, green and blue-violet—are used; but if the subtractive method is to be employed, the three additive primary filters cannot be used, since they are practically mutually exclusive, and it is necessary to adopt the three colors complementary to the additive primaries, namely: minus red—that is, blue-green; minus blue—that is, yellow; and minus green, which is magenta or purple.

It will be seen, therefore, that from the standpoint of additive mixture the three primary colors are red, green and blue, while from the standpoint of subtractive principle the primaries are minus red (blue-green), minus green (magenta) and minus blue (yellow). It should be emphasized that the laws of color mixture operating in the case of the mixture of dyes, paints, etc., are those of subtractive mixture. Thus, if two paints be mixed together the light reflected by the mixture is that which is not absorbed (that is, not subtracted) by either of the components. Colored materials viewed either by transmitted or reflected light owe their color to selective absorption; that is, subtraction. A colorimeter operating on the subtractive principle, therefore, produces the desired color in a manner directly analogous to that in which color is produced by dyeing, painting, etc., and it seems that measurements made with this type of instrument can be more easily interpreted for practical application than those expressed in terms of additive primaries.

Some years ago the author designed an instrument operating on the subtractive principle. This instru-

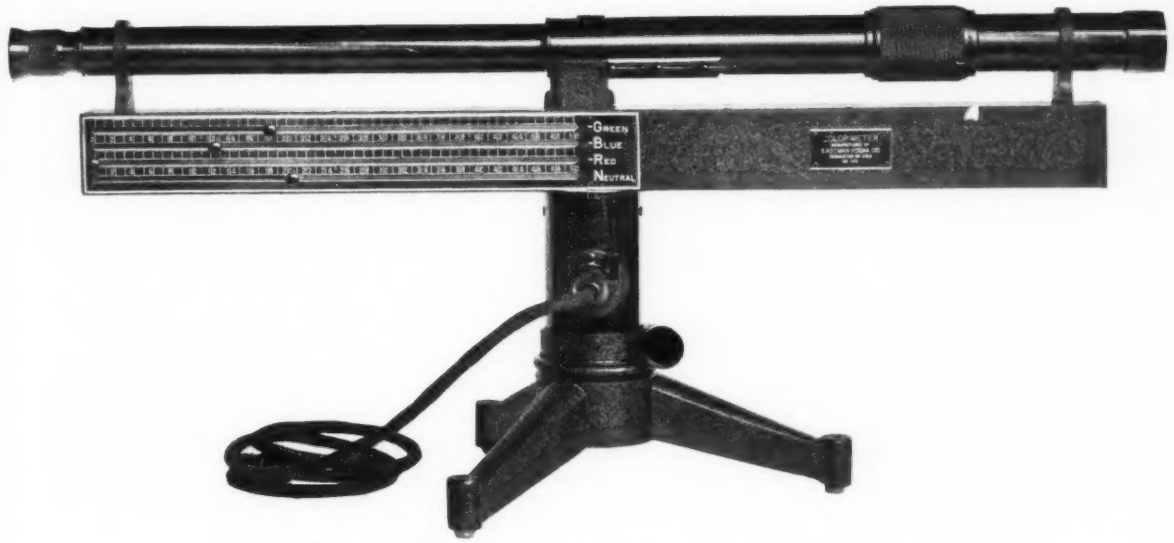

Fig. 8—*Eastman Universal Colorimeter, Showing Scale*

ment is now made and sold by the Eastman Kodak Company under the name "Eastman Universal Colorimeter." Fig. 7 is a diagram of the optical parts of this instrument. A lens system at L_1 forms an image of the object O of which the color is to be measured in the plane of the photometric prism P. This image is examined by means of the lens system L_2 and the eyepiece L_3. A diaphragm D serves as an artificial pupil and assists the observer in aligning the visual field. Two neutral gray filters, N, are provided to control the intensity of the light from the sample being measured and keep it within the range of the instrument. A filter F_2 is provided for use when samples are to be measured under definite conditions of illumination. The use of this filter will be explained later.

The photometric field is obtained by the use of a total reflecting prism P, one edge of which is ground in such a way that the light totally reflected fills one-half of the circular field (illustrated at E), while the other half is filled by light coming from or through the colored object being measured. The dividing line between the two halves of the field is very narrow, and does not interfere with the precise matching of the color of the two fields.

On the axis perpendicular to and intersecting the line of sight at the edge of the prism P is placed a light source S. This is designated as the working standard. A diffusing system G is placed as shown in order to give uniform illumination in the photometric field and as a means of controlling the brightness of the comparison field. A blue filter F_1 reduces the color of this working standard to a subjective match with noon sunlight, which has been adopted as the standard of white. The four colored gelatine wedges are placed at W, each wedge being movable in a horizontal direction so that it may be inserted to any extent or withdrawn completely from the path of the light entering the prism P from the source S. The wedge marked minus green (—Green) absorbs the green component of the white light and transmits the red and blue components. The minus blue (—Blue) wedge absorbs the blue component and transmits the red and green, while the minus red (—Red) wedge absorbs the red component and transmits the blue and green. Three auxiliary filters, A, equivalent in absorbing characteristics to the thick ends of the colored wedges, are placed as indicated and may be thrown into or out of the beam at the will of the operator. These serve to increase the range of the instrument, making the wedges effectively twice as long.

The light from the object to be measured appears in the lower half of the field E, while the upper half is illuminated by light from the working standard S. To obtain a match between the two halves of the field the wedges are adjusted so that the light transmitted by them matches the light from the object under consideration. The position of each wedge is indicated by a pointer attached to the wedge frame and reading upon a graduated scale. When a match has been obtained in the instrument, the color is designated by the scale readings of the various wedges used in obtaining the match. A photograph of the instrument is shown in Fig. 8. The positions of the scales and the pointers attached to the various wedges are indicated thereon.

As stated previously, the instrument operates on the subtractive principle of color mixture, and any desired

color is obtained in the comparison field by the subtraction of certain components of the white light used for the illumination of the comparison field. This subtraction is accomplished by the use of dyed gelatine wedges, which are made by coating dyed gelatine so that its thickness varies from zero at one end to a maximum at the other. By the use of three such wedges, each of which absorbs one of the three color additive primaries, any desired amount of each primary may be subtracted from the white light.

The method of obtaining any desired color by the subtractive mixture may be explained by reference to Fig. 9. The three rectangles in the top line of the diagram represent the three-color additive primaries—red, green and blue—of which the light emitted by the working standard lamp is composed. Now, if by some means the blue component is absorbed, we have left the red and green components, which yield yellow or minus blue; that is, if the blue component be removed from white light the remaining light will appear yellow or, in the terminology of the subtraction method, minus blue, and the wedge which serves to remove the blue component we, therefore, know as the minus blue wedge. Likewise, as indicated in the third line of the diagram, if green be absorbed, the blue and red components remain, giving a magenta or minus green. If the red component be absorbed, as indicated in the fourth line, the blue and green components remain, giving a blue-green or minus red. The action of the minus blue wedge in the colorimeter is, therefore, illustrated by the second line of the diagram in Fig. 9. When this wedge is set at zero—that is, completely withdrawn from the path of the light illuminating the comparison field—no absorption takes place; but if it is introduced into the path of the light, blue light is subtracted from the white light to a greater and greater extent as the thickness of the gelatine coating increases. When this wedge is introduced so that the point of maximum thickness is in the path of the white light, a condition similar to that indicated in the second line of the diagram exists and practically all of the blue light present in the white light of the comparison field is absorbed. Leaving the comparison field illuminated by minus blue (yellow light), the conditions existing with the minus green and minus red wedges are shown in the third and fourth lines of the diagram. It is evident that if the minus blue and minus green be inserted simultaneously, the transmitted light will be red, while if the minus blue and minus red are used together, green light will be obtained; while, as a third combination, if the minus green and minus red be used together, blue light only will be transmitted. If all three wedges are inserted all of the components of white light will be absorbed in equal proportions, causing a decrease in brightness of the light from the comparison source without any appreciable color change.

Any color whatever may be obtained by a combination of two of these wedges properly chosen with a neutral gray wedge for the control of the intensity. An exception to this statement is found in the case of the monochromatic colors occurring in the spectrum. The concentration of the dye used in the wedges is so adjusted as to give a fairly open scale for the reading of colors of low saturation and at the same time serve for colors of relatively high saturations. A measurement of color by this instrument, therefore, required the statement of three

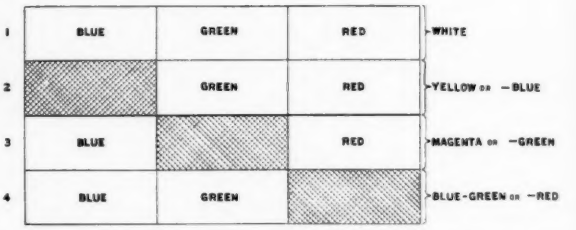

FIG. 9—*Diagram Illustrating Subtractive Color Mixture*

values, two applying to the positions of the two chromatic wedges which it is found necessary to use and one applying to the position of the neutral wedge when the balance is obtained.

The working standard lamp must be operated under definite conditions. The color of the light emitted must be such that after passing through the filter F_1 it will match subjectively the standard of white. Any change in the current flowing through the lamp causes a change in the color of the light emitted.

A control box is provided which contains the necessary variable resistance for the proper operation of the working standard lamp. A photograph of this is shown in Fig. 10. Since the color and intensity of a lamp operating at fixed current may change with age, it is necessary to check this lamp from time to time to determine the proper operating current.

To enable the user to check at any time the working standards, a reference standard is provided which consists of a carefully seasoned standardized lamp mounted in an attachment which may be fixed to the colorimeter at O, thereby illuminating the lower half of the photometric field. This reference standard is carefully seasoned, and the current determined at which it must be operated in order that the light emitted when screened by the filter F_2 may be subjectively equivalent to noon sunlight. The control box previously referred to has two outlets, into which the reference and the working standard may be plugged and operated under standard conditions simultaneously. The reference standard lamp is used only when it is necessary to check and standardize the

working standard lamps, and under such conditions it will remain constant for a long period.

A relatively small proportion of the colorimetric measurements is included in the classification of so-called "field work," where the color of objects under some fixed illumination is desired. A more extensive application is in the measurement of color in the laboratory, factory and mill. The standardization and control of the color of various products necessitate the illumination of the samples measured in a specified and reproducible manner. For this type of work it is necessary, therefore, to provide attachments suitable for holding samples of various materials and for illuminating them in a definite and reproducible manner. The color measurements must be made with the samples illuminated by white light, thus necessitating the operation of the illuminating source so as to furnish a light of definite quality. The conditions of operation applying to the working standard must, therefore, also be employed to the operation of the illuminating lamps. For convenience in examination of samples, suitable holders are provided and a lamp house containing a lamp suitable for illuminating the samples. In Fig. 11 the instrument is shown equipped with the holder for fairly thin transparent materials, such as colored glasses, celluloids or liquid cells not exceeding 1 cm. in thickness and the illuminating lamp. This lamp must be operating at such a current value that the color of the light emitted when screened by the filter F_2 will match standard white and consequently the working standard lamp. The required current can be determined at any time by comparing the illuminating lamp directly with the working standard, using the instrument itself as a means for the comparison. Both the standard lamp and the illuminating lamp can be controlled and operated simultaneously from the control box.

Special attachments are provided for the accommodation of various types of materials. For slightly colored liquids, where it is necessary to use a fairly great thickness in order to obtain sufficient color for precise measurement, a 10 cm. tube and holder are provided. For reflecting surfaces a holder is provided by means of which the sample can be illuminated by light incident at 45 degrees while the observation is normal to the surface, thus excluding the specular component of the reflected light from measurement.

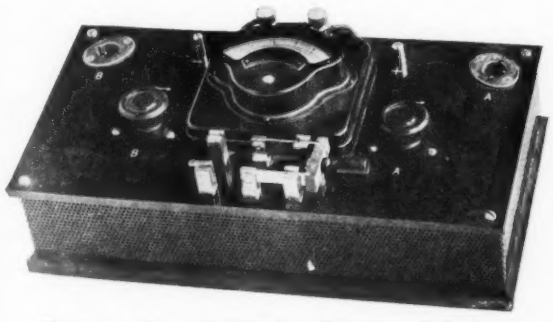

FIG. 10—*Control Box for Eastman Colorimeter*

In the case of colors which approach very closely to white, it is desirable to increase the saturation as much as possible in order to facilitate precise measurement. For such materials a tint intensifying attachment is used which takes advantage of the increase in saturation following the multiple reflection of light from successive surfaces. By this means it is possible to satisfactorily measure colors which are only just perceptibly different from white.

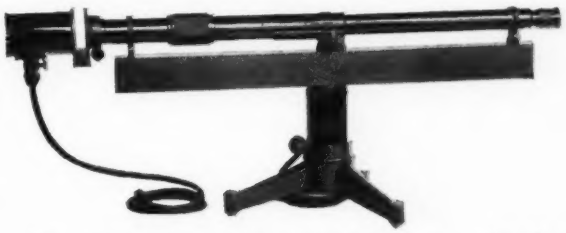

FIG. 11—*Eastman Universal Colorimeter, Showing Attachment for Holding Transparent Samples and Attachment Lamp House*

In the precise measurement of color special attention should be given to the technique of preparing the sample for measurement. Unless this is done, samples of the same material may give different results. In many cases the problem of developing the technique of preparing the sample is difficult and requires preliminary experimental work in order to be certain that satisfactory results will be obtained.

MEETING OF LOWELL TEXTILE JUNIOR SECTION

The second meeting of the Lowell Textile Junior Section of the American Association of Textile Chemists and Colorists was called to order at 3.20 p. m. on January 18, 1924, by Chairman Feindel.

The reports of the Secretary and Treasurer were read and accepted. The Chairman reported that the proposed amendment regarding junior sections of the A. A. T. C. C. had been passed and that the Lowell Textile Junior Section had been duly recognized by the parent society.

Chairman Feindel then presented Milton Washburn, of the National Aniline & Chemical Company, who spoke to the Section on his experiences in breaking into the sales end of the dyestuff business.

Mr. Washburn emphasized the importance of tech-

nical training even in the selling of dyestuffs, and showed by citing several instances that the technically trained man is regarded by the majority of mill managers as an asset, not only to the dyestuff manufacturer but also to the mill that is using the dyes.

Mention was also made by Mr. Washburn of the injustice done to American-made dyes by retailers of clothing, cloth and the like. He pointed out that in many cases the retailer would not guarantee a dyed fabric unless he, the retailer, could be assured that the fabric had been dyed with German dyes. Very often a fabric that had been dyed with American colors was said to have been dyed with German colors, especially if the particular colors were quite fast. And, again, some colors that were not very fast were reported to have been American colors but were, in fact, German colors.

Mr. Washburn also told of several amusing experiences in his travels, one of which was his means of conveyance in rural sections.

Open discussion was held after Mr. Washburn's very interesting talk, and at its close a rising vote of thanks was given the speaker.

There being no other business before the meeting, it was voted to adjourn at 4.40 p. m.

G. W. PIERCE, Secretary and Treasurer.

APPLICATIONS FOR MEMBERSHIP

Active Membership

Broadbent, Elliot, silk and cotton dyer, Glenlyon Print Works, Phillipsdale, R. I. Sponsors: Fred H. Webster and John Hutton.

Clayton, Howard D., superintendent of research, Cluett, Peabody & Co., Troy, N. Y. Sponsors: Thomas D. Ainslee and W. E. Hadley.

Graenicher, Otto F., chemist, Lyons Piece Dye Works, Paterson, N. J. Sponsors: E. H. Killheffer and Dyer S. Moss.

Knights, George W., chemist in charge, U. S. Appraiser's Stores, 641 Washington Street, New York City. Sponsors: P. Fiebiger and H. F. Wilmot.

Nutting, C. L., chemist, Arlington Mills, Lawrence, Mass. Sponsors: H. Christison and Fred Spencer.

Summers, F. P., general manager, Noil Chemical & Color Works, 152 W. 108th Street, New York City. Sponsors: H. F. Wilmot and E. H. Killheffer.

Junior Membership

Jangstetter, F. M., assistant dyer, Waldrich Bleachery, Delawanna, N. J. Sponsors: O. R. Flynn and M. W. Alling.

Walsh, George, chemist and colorist, Hasco Dyeing Company, Weehawken, N. J. Sponsors: A. F. Lichtenstein and C. A. Puller.

CHANGES OF ADDRESS

Bachelder, Charles E., 98 Stevens Street, Lowell, Mass.

Clapham, Harry, 35 Spruce Street, Westerly, R. I.

Gibson, T. H., Apartment 14, 149 Sterling Street, Brooklyn, N. Y.

Medde, Carl E., 4 Kane Apartment, 610 Delaware Avenue, Wilmington, Del.

ASSOCIATION BADGES

Those who attended the Annual Meeting of Providence had an opportunity to examine and purchase the new lapel button badges which were there distributed by the Secretary.

For the benefit of members who were unable to attend the meeting an illustration of the badge is shown herewith.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

WALTER E. HADLEY,
5 Mountain Avenue,
Maplewood, N. J.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
PROFESSOR OF CHEMISTRY AND DYEING, LOWELL TEXTILE SCHOOL
Directing Editor

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A PRAISEWORTHY MOVEMENT

LAST month a new publication entitled "Arbitration News" made its initial appearance. It is published monthly by the Arbitration Society of America and as the official organ of that society will endeavor to spread the commendable doctrine of arbitration by printing news of the society's activities.

The fundamental purposes of the Arbitration Society are: to promote more effective and speedier determination of human controversy; to simplify and clarify the law; to offer a simple, direct means of avoiding the law's uncertainties, intricacies and delays; consequently, to divert to other channels "the pouring flood of litigations which now overwhelm our courts" and "to diminish and allay the rancor and bitterness which litigation engenders and promotes."

This first issue of the Arbitration News represents a report or summary of what the society has done since its small but ambitious beginning in May, 1922. The leading article presents a brief record of the Public Tribunal in New York City which has been operating "to thoroughly test the efficacy of the Amended Arbitration Law of this State." New Jersey has also passed an Arbitration Statute modelled after New York's bill, so that the society is acting with the valuable co-operation and tacit endorsement of State legislature.

The officers and board of governors of the society are made up of such well-known financial and industrial leaders as Charles M. Schwab, Jules S. Bache and Franklin Simon, of prominent bankers, lawyers, judges, educators, Senators and corporation executives.

The record of the Tribunal contains some surprising facts. Up to December 15th of last year approximately five hundred issues have been handled by the society. Speaking of this the article says in part:

"A large number have been determined satisfactorily to the disputants in conferences preliminary to formal arbitration proceedings. The actual arbitrations have covered a wide field of commercial disputes involving the determination of claims ranging from hundreds up to thousands of dollars. The average arbitration . . . required but a single hearing and occupied but a few hours. In every recorded case the cost to the disputants was trifling in comparison with the cost of litigation. And the specially significant thing . . . is the fact that wide satisfaction has resulted from the procedure."

From this it is obvious that the common-sense principles which constitute the platform of the organization have been proven utterly sound and practicable in a manner highly encouraging to its founders.

The rapid growth of the Arbitration Society's activities is due largely to the lively co-operation of numerous outside bodies, and to the energetic efforts of its own bureaus of publicity and public speakers. Law, commercial and fraternal organizations of every character have willingly offered their support. Daily newspapers of the country, trade and general periodicals, have published countless columns of news stories pertaining to the society's movements. As a result of this wide publicity the past six months have seen a surprising increase in the number of cases submitted for judgment.

The New York World in an editorial commenting upon the society said:

"This is justice reduced to its simplest and quickest conditions. Here, indeed, for a large part of the litigation which congests our court dockets and burdens litigants, is a real remedy for the 'law's delay' and an effective form of relief from the 'law's expensiveness.' This is the fundamental of arbitration. It seeks justice rather than possible evasion through loopholes of the law. The trickster and the shyster will not favor arbitration because technicalities play no part."

In a similar comment the Evening Mail said:

"When two parties to a dispute agree to arbitration they can go before the arbitrator without fear of not being able to tell the truth and the whole truth. They can feel sure that no material fact in their favor will be ruled out under a law of evidence that sometimes seems as much aimed at beclouding as at revealing the truth."

Just now, when world peace is being advocated, any equitable system of settling disputes is a timely subject. Of course, compared with international problems and treaties, an arbitration movement here may appear insignificant. Yet, if it works on a small scale, will it not prove just as effective when applied to larger problems? The mere evidence of its incredibly rapid development indicates clearly that disputes large and small, when subjected to a little common sense, with the honest co-operation of reasonable arbitrators, can be satisfactorily settled without recourse to our imposing system of litigation as practised in our law courts. In short, the procedure adopted by the Arbitration Society of America might well be emulated in fields other than *commercial* law. So far as the dyestuff industry is concerned, The REPORTER heartily recommends the Arbitration Society as a means of avoiding much expense and delay incident to litigation.

T. C.'S COLUMN

THE YOUNG CHEMISTS' PAGE

Did anybody ever think of such a thing as a Young Chemists' Page? I can see where something of the sort would have been of special interest and value to me ten or fifteen years ago and would be thoroughly scanned now if it existed. Perhaps the idea can be made clearer by a little personal reminiscing.

Once upon a time, when fresh from school, with only a classroom knowledge of chemicals and their analysis, and with no knowledge at all of dyes and textile operations, I was thrown on my own resources to test all kinds of mill supplies, to assist in solving all sorts of mill problems, and, in truth, to introduce chemistry to a group of mills. With no other chemist in the whole town, and no correspondence column open to, or at least used for, such questions as a budding young chemist might ask, it was evident enough that many things had to be laboriously worked out or trusted to the imagination.

Every analysis was a piece of research, first to learn the properties and probable impurities of the material to be tested, then to select from the various books the best method, often by carefully trying two or three procedures, and finally the analysis itself with painstaking end-points and weighings, until the agreements were satisfactory and everything added up nearly enough to 100, so that there was no fear of the seller showing up an error in the work. Even then there were pitfalls. Once an analysis of oil of vitriol came out a couple of per cent lower than called for by the degrees Baume as tabulated in an old Chemiker Kalendar. On calling this little matter to the attention of the manufacturer, I was promptly sat upon, because the Manufacturing Chemists' Association of the United States does not use the German Baume scale and ours is 2 per cent lower, so the acid was really up to standard.

It is perhaps clear that we are trying to say that those were strenuous times. Probably the average young textile chemist of to-day is better prepared in some respects, and possibly few get as wide a range of problems all at once, but there are no doubt many times when a question answered or an explanation given would save many hours of work or the making of mistakes.

Now there is one strange thing that I have noted about chemists. They seem very much disinclined to ask questions in anything approaching a public way. Perhaps this is owing to the fact that there are frequently in our midst bright young men who appear to know about all there is of chemico-textile knowledge. Our earnest seeker after truth knows that he does not know and knows equally well that some of the others do not know, but he seems to be afraid of appearing in an unfavorable light and so keeps mum.

When in the laboratory I seldom paid much attention to the correspondence columns of the trade papers, partly because they rarely if ever showed any indication of being patronized by chemists. I have since learned, however, that very often much more in the way of good practical information is to be learned from the questions and answers than from leading articles. One reason is perhaps that each is written with a specific and definite purpose, unclouded by the necessity to cover the given subject completely, to fill a certain number of columns of space, or by other equally laudable requirements of technical exposition.

At the risk of overworking the personal pronoun and to emphasize the point that there is real value in technical correspondence I shall fall back again on personal experience. While I never asked a question of a technical nature for possibly ten years, I have more recently used such columns to very good advantage. It would seem, therefore, that our younger men could use the right kind of a column (or page) to still greater profit. Leaving entirely out of consideration processes that are actually confidential, here is about what the textile chemist wishes to know and cannot readily find in books:

The strengths and impurities, both large and small, in his every-day chemicals, as well as their uses, and the effects of the impurities.

The quickest sufficiently accurate methods of testing all supplies.

The properties of dyes and comparisons of those nominally identical.

Details of mill operations when working out new methods or as a check on present practice, where there is trouble or where improvements are desired.

Our suggestion is to find out if possible if such a page will meet with sufficient interest and serve a useful enough purpose to warrant making it a real feature of the AMERICAN DYESTUFF REPORTER. If so, to see if it cannot be made better and more useful than any other similar venture up to date.

Aside from human inertia, which we hope can be overcome by persuasion, the factor which may interfere most with success, and which may partly explain why correspondence columns are not more used, is the time necessary to get replies. Many of the difficulties that crop up are in the nature of emergencies and have to be handled as such. However, it is very important in every such case to get an explanation of what happened, even if it be but a post mortem. "An ounce of prevention is worth a pound of cure," but a few grains of understanding may beat them both.

How it can be done is beyond our present ability to say. We would suggest, however, that the inquirer and the writer of the answer may remain incognito or not as they choose; that replies by direct correspondence might be arranged to speed up some cases; that answers are preferred for publication, but can be withheld if requested.

The main requirement and the most difficult to meet will be marshalling the services of enough willing vic-

tims to answer such inquiries as do not allow time for their publication as a free-for-all, and to insure that every question shall, if possible, get an answer; not an answer copied from a book that everybody has, but one flavored with the technique that can only come from personal experience. T. C.

INQUIRY DEPARTMENT

A. V.—Question: It has been suggested that we use Epsom Salts in finishing hose dyed with Sulphur Black. Kindly advise us as to the advantages and disadvantages of this salt.

Answer: Epsom salts is commonly applied in conjunction with Monopole oil or a similar oil of this type. The purpose of the salts is really that of fixing the oil in the fiber. This treatment gives the finished hose an added luster and greatly improves the shade, particularly if the goods have been overdyed. In other words, it removes the bronze-like cast which is often evident in overdyed sulphur blacks.

The main objection to the use of this treatment is that there is a possibility of imparting to the finished goods a pasty or clammy feeling, which latter is really due to the use of an excess of oil. If the operation is carefully handled and the salts and oil are properly proportioned this clamminess is not evident, but an improvement in luster and shade is obtained.

W. J. C.—Question: Enclosed is a small cutting of white cloth which shows upon inspection a mottled whitish deposit in several places. This peculiar spot develops a brownish-black sulphide when brought in contact with the sodium sulphide of a sulphur dye bath as illustrated in the colored cutting also enclosed. Spotting with straight sulphide gives the same result. What, in your opinion, is the metal or mineral responsible for this stain? It is an obstinate thing to remove, extra souring with muriatic before dyeing having no effect. We shall greatly appreciate any advice you may be able to give us regarding the probable origin and best method of removing this stain. As the matter is pressing, we shall be glad to have your reply by mail at your earliest convenience.

Answer: We are of the opinion that the spots in question are lead stains, probably resulting from the use of white paint somewhere in your plant. The goods may have become spotted directly or, what is more probable, some calenders or squeeze rolls have been spotted and the pigment thus transferred to the goods over a considerable yardage.

The section shown marked with the red crayon was subjected to hydrogen sulphide gas which, as you know, is the active reagent in a sulphur color bath. This brought out the black stains shown, which is approximately what happened in your dyed sample. A portion of the goods was treated and we then dipped it in dilute hydrochloric acid solution which cleared the black spots entirely. Both of these reactions are to be expected if the original stain arose from the presence of lead.

The dark brown spot, outlined with black crayon, resulted from spotting the goods with a lead solution, then subjecting it to hydrogen sulphide gas and finally clearing the upper part with dilute H Cl. You will note that the action appears to be identical with that occurring where the original spots were present.

As to eradicating these spots on a commercial scale we believe that the cost would be prohibitive. It would be necessary first to give the goods a strong alkaline soaping in order to remove any oil which might be mixed with the lead and then pickle in a warm solution of strong acetic acid. While this process would probably clear the goods satisfactorily, we imagine that the cost involved would make it cheaper in the long run to sell the goods as seconds in the white state.

Trusting this information may be of some service to you, we regret that we are unable to suggest any practical means of eliminating the difficulty.

R. B. D—Question: We enclose a sample of cloth for your attention. This sample represents a lot dyed in Sulphur Blue. Of late we have been having great annoyance with this type of resist, and are baffled in our efforts to discover the cause. It is almost peculiar to our blue dyeings although rarely we get it in the pearl.

Any assistance you may find it possible to render will be appreciated.

Answer: We have examined this sample and are almost certain that the goods has not been properly cleaned before going into the dye bath. If these goods have been bleached before dyeing, as seems probable, it is possible that some of the lime or chlorine is still in the goods which would have the effect of bleaching out the dyestuff. Oil or finishing compounds remaining in the fabric would be likely to act as a result and might cause the trouble.

Without knowing what process the cloth has been through before dyeing, we would suggest that you give the goods a thorough boiling with soap and soda ash, and a good rinsing in warm water before entering into the dye bath. In other words, make sure that the goods are thoroughly clean and well wet out before they get in contact with the dye bath. If this treatment does not remedy your trouble, we would suggest investigation in your dyehouse by someone thoroughly familiar with this process.

Too much salt in the dye bath and improper oxidation are frequent sources of trouble with sulphur colors, but from the appearance of the cloth in question we believe that the trouble originates before the dyeing process is begun.

The Discussion of Three Forms of Artificial Light as a Testing Standard for Determining Fastness to Light

Six Qualifications of Testing Lights—The Incandescent Lamp—Features and Advantages—Mercury Arc in Quartz Tube—Points in Its Favor and Disadvantages—White Flame Carbon Arc—Good and Bad Features

By HENRY SPAFFORD THAYER, B.Sc.

THE six important qualifications of a satisfactory standard for testing fastness to light can be recapitulated from the previous article* as follows:

1. Must have sunlight quality.
2. Must be reproducible and uniform.
3. Must give results expressible in definite terms.
4. Must be convenient in use.
5. Must not be dangerous to the eyesight.
6. First cost and operating expense must be reasonable.

A little study will show that one or another of the various forms of electric light is best adapted to this purpose, leaving out of consideration the acetylene lamp or the Welsbach mantle lamp. At present there are available four principal forms of electric light which may be classified as follows:

A. The incandescent lamp.
B. The mercury arc.
C. The white flame carbon arc.
D. The violet carbon arc.

The first three of these lights will be discussed in this article, while the violet carbon arc will form the subject of a later paper.

The Incandescent Lamp (Gas Filled Type)

(1) The characteristic feature of the incandescent lamp, even of the gas-filled type, is that its light is especially rich in red and yellow rays, being correspondingly deficient in violet and ultra-violet. This point is best seen in the case of the so-called "daylight lamp, in which the glass is given a bluish tint. As a result the volume of light is enormously reduced, as only blue and violet rays will pass through the glass. As a result of this excess of red and yellow light the incandescent lamp gives fading results that are decidedly different from the fading of sunlight. In addition, the great heat produced in this type of lamp makes it extremely difficult to separate the effect of the light from the effect of the heat.

(2) An even more serious difficulty with the incandescent lamp is the fact that it blackens and deteriorates with age at a rate that varies in different individual lamps and at a rate that cannot be accurately determined. Also this rate and the intensity of the light are dependent upon the voltage at the lamp terminals, and it is well known that the average commercial circuit cannot be depended upon for exact voltage.

(3) Owing to this unknown rate of deterioration, it is well-nigh impossible to arrange a fading ratio in which lamp hours may be compared with sunlight hours. Such a ratio will have so many correction factors as to be of slight practical use.

(4) In respect to this classification, the incandescent lamp is very good indeed. It is wholly without mechanism, so that its mounting is simple and inexpensive, and the lamps themselves may be obtained without difficulty in all parts of the world. When attempting to use incandescent lamps, it will be found necessary to arrange some artificial cooling method, which greatly complicates the situation.

(5) The incandescent lamp is a perfectly safe lamp so far as one's eyesight is concerned, providing, of course, that the simple precaution is observed of not looking at the light too long, as the strain caused by so intense a light is very trying to the eyes. This, however, is such a natural precaution that the light may be said to be perfectly safe.

(6) The first cost of the incandescent lamp is low, but the operating cost is high when considering the cost of replacements and the necessity of using an excessive wattage to secure a speed of fading that is commercially useful. The fact that the incandescent lamp is deficient in actinic rays means that fading proceeds but slowly.

The Mercury Arc in Quartz Tube

(1) The mercury arc in quartz tube would seem to be a very suitable form of light for fading purposes, but it is open to the objection that its spectrum is so utterly different from that of sunlight that the most erratic fading results may be expected and indeed are encountered in practice. A very good reproduction of the mercury arc spectrum is given in the article by Flynn in the November 19, 1923, number of the American Dyestuff Reporter. That part of the spectrum shown under the heading "Visible" may be taken to represent the region of the solar spectrum, while the bands in the region of the shorter wave lengths are peculiar to the mercury

*American Dyestuff Reporter, December 3, 1923.

arc. As a result, the chemical action of the mercury arc light shows extreme variations from the action of sunlight as expressed by Dr. Bancroft:

"It is perfectly true that ultra-violet light will fade certain dyes fairly rapidly, and, therefore, it does give an accelerated test; but it may be an entirely false one, because the dye in ordinary use may be faded by red light which one does not get from ultra-violet at all; and, furthermore, the use of the ultra-violet lamp is bad, because that being done in air is always going to make a certain amount of ozone, in which case the dye is being bleached by ozone, whereas, in general, under ordinary conditions, dyes do not bleach in light from ozone."

The use of various glass filters has been suggested as a remedy, but the complexity of the subject and the diminution in the fading power of the light, as a result of the use of glass, have impeded progress in this respect.

(2) Quartz possesses the very peculiar property of gradually turning into glass with age, and, furthermore, the rate at which this change takes place seems to vary between wide limits, as reported by different observers. If this rate were dependable and uniform, it would be within the bounds of possibility to use appropriate recalibration tables, or, as has been suggested, to gradually increase the voltage at the lamp terminals, depending on the number of hours use the lamp has had. With this change from quartz to glass comes, of course, a change in the spectrum of the light emitted. The action of all these varying factors makes impossible any more than a rough approximation of uniformity.

(3) In so far as the fading quality and power of the mercury arc may be kept uniform by means of voltage regulation, recalibration tables and glass filters, it may be considered that fading results are expressible in definite terms. When it comes, however, to expecting that these various factors will be properly co-ordinated in the hands of users all over the world, the difficulty of the problem becomes apparent. In fact, it may be said that, while the mercury arc may to some extent satisfy each individual user for his own particular work, it cannot very well be regarded as a satisfactory standard in the world's markets. A concrete example will, perhaps, make this clear. The Marine Corps Depot at Philadelphia is using a certain type of testing method to check up the half million yards of khaki cloth being delivered by the firm of Spinner & Co., of Manchester, England. It is readily seen that the testing method employed at Philadelphia must in all respects agree with the testing method in Manchester, if both purchaser and manufacturer are to work on a definite basis.

(4) In regard to convenience, the mercury arc is very acceptable. It is compact and portable and reasonably simple, perhaps the only exception being that a rectifier is required when the user's circuit is alternating current.

(5) Unlike most other illuminants, the mercury arc in quartz tube is extremely dangerous to one's eyesight, only a few seconds' exposure in some cases being required to cause serious and permanent injury. The extreme potency of this light may be illustrated by its use in sterilizing water, in which case the passage of a stream of water past the light is sufficient to destroy bacterial life. Of course, a person using such a light expects to take suitable precautions, but nevertheless, it remains at all times a potential source of danger.

(6) The first cost of the mercury arc lamp is reasonable, while its economy in current consumption is an attractive feature. This economy is somewhat lessened by glass filters that may be used. The replacement cost of the quartz tube is sufficiently high to be a serious drawback to the extensive use of the lamp.

White Flame Carbon Arc

(1) This type of arc reproduces the quality of sunlight with great faithfulness. It is for this reason that the white flame arc is used almost exclusively in engraving and lithographic plants for the reproduction of such colored objects as paintings, rugs, posters and similar subjects. Even those plants equipped with the finest daylight studios make extensive use of this type of lamp.

(2) and (3) The light from the white flame arc is uniform in power and is easily reproducible. The light shows only slight fluctuations in power with moderate changes in voltage, and the white flame carbons used may be obtained in all commercial centers.

(4) The most serious difficulty with the white flame arc is the great amount of heat produced. The power consumption of this arc is enormous and it is a hard matter to dissipate the heat. As a result, the test specimens have to be kept so far from the arc that the fading power of the light is greatly reduced, in accordance with the well-known law of inverse squares. In addition, the carbons are consumed rapidly, so that they must be changed every four or five hours, thus making it impossible to leave the test lamp running overnight without attention.

(5) So far as safety of the light is concerned, it is in the same class with the incandescent lamp; that is, it has a powerful light that will cause eye fatigue if looked at too long.

(6) The first cost of the white flame arc lamp is reasonable enough, but the operating cost is high indeed. The current consumption is much greater than in the case of the enclosed type of arc lamp, and, in addition, the white flame electrodes are very expensive and are rapidly consumed. These points, together with the excessive heat produced, have combined to prevent the adoption of the white flame arc for testing purposes except in isolated cases.

The Pennsylvania Dye & Bleach Works, Inc., New Cumberland, Pa., are reported considering plans for building a two-story addition.

Foreign Dyes Imported Through the Port of New York During January

Compiled by the Chemical Division of the Bureau of Foreign and Domestic Commerce, in Collaboration with the Chemical Division of the United States Tariff Commission

KEY TO ABBREVIATIONS FOR FOREIGN MANUFACTURERS

1—The Six Leading German Companies

A—Actien-Gesellschaft fur Anilin-Fabrikation, Berlin. Founded 1873. Branches in France and Russia.
B—Badische Anilin-und Soda-Fabrik, Ludwigshafen on the Rhine. Founded 1865. Branches in France and Russia.
By—Farbenfabriken vorm. Friedr. Bayer & Co., Leverkusen on the Rhine. Founded 1862. Branches in France and Russia.
C—Leopold Cassella & Co., Frankfort on the Main. Founded 1870. Branches in France and Russia.
K—Kalle & Co., A. G., Biebrich on the Rhine. Founded 1870. Branches in Russia.
M—Farbwerke vorm. Meister Lucius & Bruning, Hochst on the Main. Founded 1862. Branches in France and Russia.

2—The Seven Smaller German Companies

BK—Leipziger Anilinfabrik Beyer & Kegel, Furstenberg near Leipzig. Founded 1882.
GG—Chemikalienwerk Greishem G.m.b.H., Griesheim on the Main. Founded 1881.
CJ—Carl Jager G.m.b.H., Anilinfarbenfabrik, Dusseldorf. Founded 1823.
GrE—Chemische Fabrik Griesheim-Electron, Offenbach on the Main. Founded 1842.
L—Farbwerk Muhlheim vorm. A. Leonhardt & Co., Muhlheim on the Main. Founded 1879. Branch in France.
tM—Chemische Fabriken vorm. Weiler ter Meer, Uerdingen on the Rhine. Founded 1877.
WD—Wulfing, Dahl & Co., A. G. Barmen. Founded 1842.

3—Dutch, Belgian and French Companies

FA—Farbwerk Ammersfoort, Ammersfoort, Netherlands. Founded 1888.
NF—Niederlandische Farbe-und Chemikalienfabrik Delft, Netherlands (Delft). Founded 1897. Branch in Russia.
LG—Lazard Godchaux, of Brussels. (These products are probably compounded largely from the dyes made by A. Wiescher & Co., of Haeren, Belgium.)
P—Societe Anonyme des Matieres colorantes et produits chimiques St. Denis (formerly A. Poirrier), St. Denis, near Paris, France. Founded 1830.

4—Swiss Companies (all at Basel)

DH—Farbwerke vorm. L. Durand, Huguenin & Co. Founded 1871. Branches in Germany and France.
G—Anilinfarben-und Extract-Fabriken vorm. Joh. Rud. Geigy. Founded 1764. Branches in France, Germany and Russia.
I—Geselfschaft fur chemische Industrie. Founded 1885. Branch in France.
S—Chemische Fabrik vorm. Sandoz & Co. Founded 1887.

5—English Companies

BAC—The British Alizarin Co., Ltd. Established 1882.
ClCo—The Clayton Aniline Co., Ltd., Clayton, near Manchester. Founded 1876.
CK—Clauss & Co. (formerly Clauss & Ree), Clayton, near Manchester. Founded 1890.
CV—Colne Vale Chemical Co., Milnsbridge, near Huddersfield.
RHS—Read Holliday & Sons, Ltd., Huddersfield. Founded 1820. (Purchases by British Dyes, Ltd.)
BD—British Dyes, Ltd. Founded 1915.
Lev—Levinstein, Ltd., Crumpsall Vale, near Manchester. Founded 1864.
Q—Importations of unknown source, through dealers in colors.

IMPORTS of coal-tar dyes for January, 1924, totaled 228,743 pounds, with invoice value of $232,571. This represents an increase over the imports of December, 1923, when they totaled 202,704 pounds, valued at $212,851.

In addition to the above, the imports of dyes through the port of Boston totaled 8,900 pounds, with an invoice value of $4,507, and through the port of Philadelphia 1,000 pounds, valued at $790.

The five leading dyes in quantity imported were: Indanthrene Blue RS, 15,090 pounds; Helindone Pink R, 11,500 pounds; Indanthrene Golden Orange R, 10,791 pounds; Ciba Bordeaux B, 9,792 pounds, and Chlorantine Fast Brown, 8,488 pounds. Of the total quantity imported during the month of January, 41 per cent came from Germany, compared with 68 per cent for the previous month; 32 per cent from Switzerland, compared with 14 per cent for the previous month, and 8 per cent from Belgium, 6 per cent from Italy (the same as for the month of December, 1923), 5 per cent from England, 3 per cent from Canada, 3 per cent from France and 2 per cent from all other countries.

Imports of synthetic aromatic chemicals during January, 1924, totaled 3,448 pounds, with an invoice value of $8,854, compared with an import of 3,349 pounds, valued at $6,515, for the month of December, 1923.

During January, 1924, there were no imports of color lakes. In December, 1923, imports totaled 28,286 pounds, with an invoice value of $8,552.

The dyes in this report are grouped by Schultz numbers, and in the case of those which could not be identified by Schultz number the classification according to the ordinary method of application was adopted. As the pastes and powders of the vat dyes vary widely in strength and quantity, each vat dye has been reduced—in nearly every case—to a single-strength basis.

The designation "†" for *competitive* and "*" for *non-competitive* indicates the appraisement basis for the assessment of the ad valorem duty in Paragraph 28 of the Tariff Act of 1922. Those dyes without designation are doubtful, pending further investigation.

The ad valorem rate for competitive dyes is based on the American selling price as defined in Subdivision (f) of Section 402 of Title IV; the ad valorem rate for non-competitive dyes is based on the United States

value as defined in Subdivision (d) of Section 402 of Title IV of the Tariff Act of 1922.

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
28	Hansa Yellow G	120
	Hansa Yellow G Pdr.—(M)	
58	Alizarine Yellow R	500
	Ultra Orange R—(S)	
66	Amido Naphthol Red 6B	24
	†Amido Naphthol Red N2B—(CN)	
73	Helio Fast Red	20
	Lithol Fast Scarlet RN Pdr.—(B)	
118	Geranine	110
	†Geranine G—(By)	
140	Curcumeine	440
	*Chromocitronine R—(DH)	
154	Palatine Chrome Brown	3
	Palatine Chrome Brown WN—(B)	
158	Chrome Brown RR	1,102
	*Chrome Brown RW—(G)	
175	Ponceau for Silk	220
	*Acid Ponceau E—(G)	
177	Mordant Yellow	803
	Mordant Yellow G—(B)	
	*Milling Yellow O—(C)	
	Milling Yellow O3G—(A)	
202	Palatine Chrome Red	3
	Palatine Chrome Red B—(B)	
206	Diphenyl Catechine	4,250
	*Diphenyl Catechine G Supra—(G)	
222	Janus Yellow G	400
	Yellow JG—(M)	
227	Brilliant Croceine	100
	Cotton Scarlet Extra—(B)	
274	Diaminogene	1,002
	Diaminogene Extra—(6)	
	Diazo Indigo Blue 3RL—(By)	
296	Cotton Yellow	1,102
	†Benzo Fast Yellow RL—(By)	
313	Congo Rubine	2
	Congo Rubine 80%—(By)	
319	Diamine Scarlet	260
	*Diamine Brilliant Bordeaux R—(C)	
	Benzo Scarlet BC—(By)	
348	Diphenyl Brown	1,102
	†Diphenyl Brown GS—(G)	
358	Diphenyl Red	668
	Chloramine Red 8BS—(By)	
	*Toluylene Red —(Gr.E)	
400	Acid Anthracene Red	10
	Acid Anthracene Red 3B—(By)	
449	Trisulphon Brown	1,598
	*Trisulphon Brown B Conc.—(S)	
456	Benzo Fast Blue	530
	†Benzo Fast Blue 4GL—(By)	
476	Benzamine Brown 3GO	2
	Benzochrome Brown G—(By)	
498	Turquoise Blue	4
	Turquoise Blue G—(By)	
	Turquoise Blue BB—(By)	
512	Magenta	10
	Magenta AB Pdr.—(Q)	
515	Methyl Violet	200
	Methyl Violet NFB—(B)	
	Methyl Violet 5R Extra—(M)	
516	Crystal Violet	1,600
	†Crystal Violet Extra Pdr.—(B)	
518	Ethyl Purple	2,000
	*Ethyl Violet—(B)	
523	Fast Green	661
	Fast Green Extra Bluish—(By)	
527	Acid Violet 4BN	99
	Acid Violet 8B Extra—(By)	
530	Acid Violet	100
	Acid Violet 4BLO—(M)	
531	Eriocyamine	7,716
	Eriocyanine AC—(G)	
539	Soluble Blue	300
	Soluble Blue T—(B)	
543	Patent Blue	1,500
	†Patent Blue V—(C)	
546	Cyanol	1,317
	*Cyanol FF—(C)	
	*Blue Extra—(C)	
559	Victoria Blue B	100
	Victoria Blue B Highly Conc.—(B)	
560	Night Blue	440
	Night Blue—(B)	
562	Fast Acid Blue	1,602
	Acid Blue RBF—(S)	
	Brilliant Wool Blue FFR Extra—(By)	
564	Naphthalene Green	551
	†Naphthalene Green V—(M)	
571	Rhodamine 6G	2,732
	*Rhodamine 6GDN Extra—(B)	
573	Rhodamine B	3,845
	†Rhodamine B Extra—(B)	
	Rhodamine B Extra—(S)	
	†Rhodamine B Extra—(Q)	
580	Fast Acid Violet B	100
	Fast Acid Violet B—(M)	
603	Acridine Orange	506
	†Rhoduline Orange NO	
	Brilliant Acridine Orange A—(DH)	
606	Phopshine	929
	†Coriophosphine OX Extra—(By)	
	Leather Yellow A Pdr.—(Q)	
608	Euchrysine	122
	†Euchrysine G Extra—(By)	
618	Thioflavine T	2,082
	Thioflavine T—(C)	
	*Tioflavine TCN—(C)	
	Basic Yellow T—(C)	

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
627	Anthracyanine	441
	*Modern Royal Blue—(DH)	
635	Modern Violet	110
	*Blue 1900 TCD—(DH)	
645	Gallazine	220
	Gallazine 90—(DH)	
659	Methylene Blue	1
	Toluidine Blue TN—(M)	
672	Azo Carmine	2,000
	Azo Carmine GX—(B)	
684	Rhoduline Violet	2
	Rhoduline Red B—(By)	
699	Induline (water soluble)	100
	Induline NN—(B)	
709	Pyrogene Green	4,360
	†Pyrogene Green 3G—(I)	
754	Kryogene Violet 3RX	400
	Kurgan Violet 3RX—(B)	
759	Anthraflavone G	4,060
	Anthraflavone GC Pst.—(B)	
	Anthra Yellow GC Pst.—(B)	
760	Indan. Golden Orange G (sgle. stngth.)	1,710
	Vat Golden Orange G Dbl. Pst.—(B)	
	Duranthrene Golden Orange Y Pst.—(BD)	
761	Indan. Golden Orange R (sgle. stngth.)	10,791
	*Indan. Golden Orange RRT Pst.—(B)	
	*Helindone Golden Orange IRRT Pst.—(M)	
	Helindone Golden Orange IRRT Pdr.—(M)	
	*Vat Orange RRT Pst.—(B)	
763	Indan. Dark Blue BO	300
	Indan. Dark Blue BO Pst.—(B)	
765	Indan. Green B (sgle. stngth.)	864
	†Indan. Black BB Dbl. Pst.—(B)	
767	Indan. Violet RR (sgle. stngth)	220
	†Indan. Violet RR Dbl. Pst.—(Q)	
774	Alizarine Black	653
	Alizarine Black S Pst.—(M)	
	Alizarine Black WR—(B)	
778	Alizarine, Synthetic 20% Pst.	619
	†Alizarine VI Extra Pure—(B)	
	Alizarine Red DIB New—(M)	
779	Alizarine Orange	3
	Alizarine Orange SW Pdr.—(B)	
780	Alizarine Red	323
	Alizarine Red S Pdr.—(B)	
	Alizarine Red W Pdr.—(By)	
785	Alizarine Red RG, GI	1,000
	Alizarine Red SDG Pst.—(M)	
790	Acid Alizarine Blue	493
	Acid Alizarine Blue BBN—(M)	
	Anthracene Blue SWR—(B)	
	Anthracene Blue SWGG Ex.—(B)	
792	Cibanone Orange R (sgle. stngth.)	5,296
	*Cibanone Orange R Pdr.—(I)	
816	Algol Red 5G (sgle. stngth.)	440
	Algol Red 5G Pdr.—(By)	
817	Algol Yellow R	661
	*Algol Yellow R Pst.—(By)	
819	Algol Red FF, R (sgle. stngth.)	440
	Algol Red R Extra Pdr.—(By)	
820	Algol Brilliant Violet R (sgle. stngth.)	4,708
	*Duranthrene Brilliant Violet R—(BD)	
	Vat Brilliant Violet RK Pst.—(By)	
	Vat Brilliant Violet RK Pdr.—(By)	
827	Indan. Claret B Extra	2,000
	Anthra Claret R Pst.—(B)	
831	Indan. Red BN (sgle. stngth.)	4,438
	Duranthrene Red BN Pst.—(BD)	
	Helindone Red IBN Extra Pdr.—(M)	
	Helindone Red DIBN Pst.—(M)	
	Indan. Red BN Extra Pdr.—(B)	
	Vat Red BN Extra Pst.—(B)	
	Vat Red RK Pst.—(B)	
	Vat Red RKP—(B)	
832	Indan. Violet RN (sgle. stngth.)	3,203
	Indan. Violet BN Pst.—(B)	
	Indan. Violet BN Extra Pdr.—(B)	
	Helindone Violet IBN Pst.—(M)	
	Helindone Violet IBN Extra Pst.—(M)	
833	Algol Olive R (sgle. stngth.)	1,760
	Algol Olive R Pdr.—(By)	
838	Indan. Blue RS (sgle. stngth.)	15,090
	Indan. Blue RS Triple Pdr.—(B)	
	Vat Blue RSP Dbl. Pst.—(B)	
840	Indan. Blue 3G (sgle. stngth.)	10
	Vat Blue 3G Pdr.—(B)	
841	Indan. Blue GGS (sgle. stngth.)	35
	Vat Blue GGSL Pdr.—(B)	
842	Indan. Blue GCD (sgle. stngth.)	2,092
	Indan. Blue GCD Dbl. Pst.—(B)	
844	Algol Blue 3G (sgle. stngth.)	80
	Algol Blue 5G Pdr.—(By)	
849	Indan. Yellow (sgle. stngth.)	440
	Indan. Yellow G Pdr.—(B)	
851	Alizarine Direct Blue B	80
	Alizarine Direct Blue B—(Q)	
852	Alizarine Irisol D, R	455
	*Alizarine Blue JR Pdr.—(By)	
	*Alizarine Irisol R—(By)	
	Alizarine Irisol R Pdr.—(By)	
854	Alizarine Viridin	1,257
	*Alizarine Viridin FF Pst.—(By)	
855	Alizarine Pure Blue B	1,633
	Alizarine Sky Blue B—(By)	
856	Alizarine Astrol	1,772
	*Alizarine Blue AS Pdr.—(By)	
858	Alizarine Saphirol B	797
	†Alizarine Saphirol SE—(By)	

Schultz No.	Name of Dye and Manufacturer	Quantity (pounds)
860	Cyananthrol G	1,410
	Cyananthrol BGAOO—(B)	
	*Alizarine Direct Blue BGAOO—(B)	
861	Anthraquinone Blue SR	3
	Anthraquinone Blue SR Extra—(B)	
862	Alizarine Blue Black	2,202
	†Alizarine Blue Black B Pdr.—(By)	
865	Alizarine Direct Green G	807
	Aliz. Cyanine Green G Ex. Pdr.—(By)	
867	Indan. Brown (sgle. stngth.)	1,462
	Anthra Brown B Dbl. Pst.—(B)	
869	Algol Brown B (sgle. stngth.)	5,907
	Vat Brown R Pst.—(By)	
	at Brown R Pdr.—(B)	
874	Indigo, Synthetic (sgle. stngth.)	9
	Indigo Vat—(B)	
883	Indigo KG (sgle. stngth.)	500
	Indigo MLB6B Pdr.—(M)	
906	Thioindigo Scarlet G	551
	Ciba Red G Pst.—(I)	
907	Ciba Scarlet (sgle. stngth.)	2,011
	Ciba Scarlet G Extra Pst.—(I)	
	Thioindigo Scarlet GG Pst.—(K)	
908	Ciba Red R	1,323
	Ciba Red R Pst.—(I)	
910	Helindone Pink	998
	Helindone Pink AN Pst.—(M)	
	Helindone Pink BN Pst.—(M)	
912	Thioindigo Red B (sgle. stngth.)	2,753
	Ciba Pink BG Pst.—(I)	
	*Ciba Pink BG Pdr.—(I)	
915	Helindone Fast Scarlet R (sgle. stngth.)	5,000
	Helindone Fast Scarlet R Pdr.—(M)	
918	Helindone Red 3B	5,335
	Helindone Red 3B Pst.—(M)	
	Helindone Red 3B Pdr.—(M)	
	Vat Red Violet RH Pst.—(B)	
919	Ciba Bordeaux B (sgle. stngth.)	9,792
	Ciba Bordeaux B Pst.—(I)	
	Ciba Bordeaux B Pdr.—(I)	
920	Helindone Violet (sgle. stngth.)	500
	Helindone Violet B Pdr.—(M)	
923	Ursol	315
	Fur Brown O, P—(A)	
	Fur Gray Brown SLA—(A)	
	Fur Blue Black SDF—(A)	

UNIDENTIFIED DYES

Acid Dyes

Name of Dye and Manufacturer	Quantity (pounds)
*Alizarine Emeraldole G—(By)	210
Alizarine Rubinol	1,233
Alizarine Rubinol 3G—(By)	
Alizarine Rubinol 5G—(By)	
Alizarine Rubinol GW—(By)	
*Alizarine Rubinol R—(By)	
Brilliant Milling Blue B—(C)	200
Brilliant Purple R—(By)	2
Brilliant Red B—(By)	2
Cloth Fast Yellow G—(I)	220
Guinea Fast Red 2R—(A)	200
New Bordeaux RX—(B)	50
Orange N, NC—(By)	4
Polar Red G Conc.—(G)	882
*Supramine Blue R—(By)	220
*Supramine Yel'ow R—(B)	110

Vat Dyes

Algol Brown G (slge. stngth.)—(By)	880
Helindone Brown IR Pst.—(M)	500
†Helindone Pink R Extra Pst.—(M)	11,500
Hydron Pink FF (sgle. stngth.)—(C)	5,660
*Hydron Scarlet 2B Pst.—(C)	1,320
*Hydron Scarlet 3B Pst.—(C)	220
Indan. Brown G Pst.—(B)	550
Indan. Blue BCD Pst.—(B)	800
Indan. Golden Orange 3R Pst.—(B)	153
†Indan. Pink B Extra Pst.—(B)	1,844
Vat (Indan.) Gray BTR Pst.—(B)	1
Vat (Indan.) Gray RRH Pst.—(B)	1
*Vat (Indan.) Red Violet RRK Pst.—(B)	2,804

Mordant and Chrome Dyes

†Anthracene Chromate Brown EB—(C)	1,119
Brilliant Chrome Blue 2B—(DH)	110
Chromorosamine BB—(DH)	22
*Chromorhodine BN—(DH)	441
*Chromoxane Brilliant Blue G—(By)	516
†Eriochrome Flavine A Conc.—(G)	1,102
Metachrome Brown 6G—(A)	300
Metachrome Olive 2G—(A)	500
Metachrome Violet B—(A)	200
Palatine Chrome Black CSB—(B)	3
Palatine Chrome Blue 2B—(B)	3
Solochrome Brown MO Pst.—(BD)	50

Direct Dyes

Benzo Fast Black L—(By)	328
*Benzo Fast Bordeaux 6BL—(By)	579
Benzo Fast Brown 3GL—(By)	152
Benzo Fast Eosine BL—(By)	2
Benzo Fast Heliotrope	432
*Benzo Fast Heliotrope BL—(By)	
*Benzo Fast Heliotrope 4BL—(By)	
*Benzo Fast Heliotrope 5RH—(By)	
Benzo Fast Orange 2RL—(By)	201
Benzo Fast Yellow GL—(By)	2
*Benzo Light Gray BL—(By)	551
*Brilliant Fast Blue 2G—(By)	390
Brilliant Sky Blue 8G Extra—(Q)	146
*Chlorantine Fast Blue 2GL—(I)	4,409
Chlorantine Fast Brown 3GL, RL—(I)	8,488

Name of Dye and Manufacturer	(pounds) Quantity
Columbia Fast Leather Brown BX, GX, RX, 3R—(A)	20
Diamine Fast Bordeaux 6BS—(C)	165
†Diamine Fast Orange EG—(C)	500
*Diamine Fast Orange E, R—(C)	493
Diamine Orange F—(C)	500
Diamine Steel Blue L—(C)	50
Diazanil Blue 2R—(M)	3,984
Diazo Brilliant Green 3G—(By)	300
Diazo Brilliant Orange 5G Extra—(By)	2
Diazo Brown 3G—(By)	52
†Diazo Fast Black SD—(By)	200
Diazo Fast Green BL—(By)	2
Diazo Fast Scarlet BL—(By)	2
Diazo Fast Violet BL—(By)	2
Diazo Fast Yellow G, 2G—(By)	4
Diazo Rubine B—(By)	2
Diazo Sky Blue 3G, 3GL—(By)	222
†Daizophenyl Black V—(G)	4,409
Direct Fast Black B—(I)	4,409
Fast Cotton Orange 2RL—(A)	100
Fast Cotton Rose 2B—(A)	5
Half-Wool Blue 3R—(By)	97
Heliotrope 3B—(By)	2
*Naphthogene Blue 2B—(A)	752
†Polyphenyl Blue GC—(G)	661
Toluylene Fast Brown 3G—(By)	220

Sulphur Dyes

*Cross-Dye Green B—(BD)	3,520
Pyrogene Brown G—(I)	2,204
*Tionol Brown O—(BD)	4,480

Basic Dyes

Brilliant Acridine Orange 5R—(DH)	220
Brilliant Rhoduline Blue R—(By)	2
Rhodamine Blue GG Extra—(By)	2
*Rhodamine Blue 3GO—(By)	55
Rhodamine Red G—(By)	2
Rhodamine Sky Blue 3G—(By)	2
Rhoduline Sky Blue BB—(By)	2

Spirit Soluble or Color Lake Dyes

Azonine R—(C)	10
Japan Black Extra—(B)	500
Typophor Red FG—(B)	7

Unclassified Dyes

Green FFL—(By)	2
Vulcan Beta Red—(B)	2
Vulcan Black Extra—(B)	2
Vulcan Blue GGS—(B)	2
Vulcan Bordeaux BL—(B)	2
Vulcan Green B—(B)	2
Vulcan Orange G—(B)	2
Vulcan Red B—(B)	2
Vulcan Red BN—(B)	2
Vulcan Red 3BN—(B)	2
Vulcan Red C—(B)	2
Vulcan Red DK—(B)	2
Vulcan Red F, G—(B)	2
Vulcan Rubine BK—(B)	2
Vulcan Scarlet B—(B)	2
Vulcan Scarlet RN—(B)	2
Vulcan Violet A—(B)	2
Vulcan Violet BN—(B)	2
Vulcan Violet RRN—(B)	2
Vulcan Yellow FR—(B)	2
Vulcan Yellow GN—(B)	2
All other aniline dyes(Q)——	113

MATHIESON ADVANCES BLEACH PRICES

The Mathieson Alkali Works, Inc., announces a further advance in its prices of liquid chlorine and bleaching powder, effective February 14, 1924, to apply on all business for future delivery taken after that date, as follows:

Bleaching Powder for spot sales and contracts for future delivery in carloads.

$1.75 per 100 pounds in standard (700-pound) drums, f. o. b. Niagara Falls.

$2.00 per 100 pounds in small (300 and 400 pound) drums, f. o. b. Niagara Falls.

Shipments in less than carloads, spot or contract, fifteen cents (15 cents) per 100 pounds above these prices.

Liquid Chlorine for spot sales and contracts for future delivery in tank car lots and in cylinders.

$4.00 per 100 pounds (single units or multi units) f. o. b. Niagara Falls.

$5.00 per 100 pounds in cylinders, in carload lots, f. o. b. Niagara Falls.

$5.50 per 100 pounds in cylinders, for sales of more than one ton f. o. b. Niagara Falls.

$6.50 per 100 pounds in cylinders, for sales of one ton and less f. o. b. Niagara Falls.

Persistent, though unfounded rumors of an American-German dye alliance have gained considerable circulation during the last few weeks, particularly since the report of the British combine. One such story became current when Paul Pickhardt, of Kuttroff, Pickhardt & Co., American sales agents for the Badische Anilin, sailed for Germany recently. These frequent reports have been repeatedly denied by several American dye manufacturers. A statement of the Grasselli Chemical Company said in substance that contrary to newspaper reports they have had no positive information that a Bayer Company representative is en route to the United States to effect an agreement with American firms.

Technical Notes from Foreign Sources

Transparent Effects in Cotton Fabrics

A French patent has been issued on a process for procuring transparent effects in cotton fabrics. The process consists first in treating the fabric with a solution of a weak acid, as, for example, with sulphuric acid at a concentration of from 49 to 50.5 deg. Be at the ordinary temperature for a period of three minutes. Then after the fabric has been washed and dried while subjected to very strong stretching, it is treated with a stronger acid of 52 to 54 deg. Be concentration. This treatment is also carried out at the ordinary temperature and lasts for three to five seconds. Then the cotton goods are washed once again and thoroughly rinsed. The next step is to subject the fabrics to treatment with a caustic soda solution of 35 to 40 deg. Be. The action of the alkali mercerizes the cotton and lasts for several seconds.

The fabrics that are treated in this manner are transparent and possess a high silky luster. In place of sulphuric acid it is possible to employ phosphoric acid of 55 to 57 deg. Be, hydrochloric acid of 1.19 specific gravity, nitric acid of 43 to 46 per cent concentration, a chloride of zinc solution or a solution of copper oxide in ammonia. The treatment of the cotton fabric may be carried out at a temperature of 60 to 70 deg. Cent. Mixed cotton fabrics as well as pure cotton fabrics may be treated in this manner.

Colloid Chemistry of Dyeing

The colloid aspect of dyestuffs and of dyeing is discussed. In the examination of dyes as to their character by the rate of diffusion into a gelatine jelly, it is preferable to measure the distance, not to the extreme edge of the diffused color, but to the point at which the original concentration is reduced to one-tenth. All textile dyes are found to diffuse, their ultimate particles falling between molecular and colloid dimensions. The substantive and Indanthrene dyes for vegetables fibers approach more nearly to colloids, whereas the acid and basic dyes for animal fibers are of more nearly molecular dimensions.

Dyeing Semi-Wool Fabrics

F. Bayer & Co. has secured a process on the dyeing of semi-woolen fabrics. These fabrics are mordanted with sulphur derivatives of phenol and various substituted compounds of the same, and may then be dyed with basic dyestuffs or acid dyestuffs that contain basic groups. In dyeing the semi-woolen fabrics which are mordanted in this manner the process is carried out in neutral dye liquors or those that have been slightly acidified with acetic acid. The dyestuffs first go on the cotton part of the fabric, and when the temperature is increased to 80 deg. Cent., the woolen part of the fabric is dyed as well.

Acid dyestuffs with basic groups, such as Acid Green, Acid Violet, Brilliant Acid Green 6B, Patent Blue, Alkali Violet and others can be employed in this process in the place of basic coloring matters. For example, the semi-woolen fabric which has been mordanted with the sulphur derivative of phenol is dyed in a bath that contains 0.75 per cent of diamond fuchsine with the addition of 5 per cent of acetic acid. The dyeing process starts at the temperature of 40 deg. Cent., and at the end of an hour the temperature has been increased to a maximum of 75 deg. Cent.

Recovery of Caustic Soda from Mercerized Fabrics

A new British process has been patented for the recovery of the values of caustic soda from the wash liquors in the mercerization of cotton fabrics in which a slotted pipe is arranged parallel to the main slotted pipe, and then the whole apparatus is fixed within a vessel containing water. The fabrics, after mercerization, are drawn between the two slotted pipes, steam being forced through it by means of the upper pipe and water drawn through it by means of the lower pipe, so that rapid removal of caustic soda from the fabric is effected. Side plates or wings may be attached to the pipes, so that the action of the steam is confined to the fabric passing over the lower slotted pipe.

Manufacture of Artificial Silk

In the cupra-ammonium process of manufacturing artificial silk, the solution of cellulose is squirted into a precipitating bath which consists of a layer of relatively cold water, in which the thread is drawn out and superimposed on a layer of hot water in which the thread is hardened. The process, which is described in British Patent No. 194,666, as aforedescribed, is modified in order to permit of its being used in the manufacture of threads of one to three deniers from solutions of cellulose ethers, esters and the like.

The change in the process consists in reversing the procedure as outlined above, so that the thread is drawn out in a hot layer of liquid. The temperature of this liquid, its depth and intrinsic nature, depend on the character of the solution it is desired to spin. The thread is then hardened in an underlying cooler layer of liquid arranged to circulate in the direction of travel of the filament. The manner in which the process is carried out can best be understood from an example.

Cellulose acetate soluble in acetone is dissolved in dry pyridine bases to give a 20 to 25 per cent solution. This is then filtered and spun in an apparatus of the regular type, provided with apertures 0.6 millimeter in diameter. Water at a temperature of 60 deg. Cent. is introduced at a rate of 30 to 50 cubic centimeters per minute at the

top of the spinning chamber, which should be previously filled with cold water. It forms a layer three to five centimeters deep, having a temperature of 45 to 55 deg. Cent. Cold water is then introduced into the funnel and a speed of spinning of 40 meters per minute is sufficient provided that the length of the funnel, together with the tube leading from it, is between 25 and 30 centimeters.

During their passage through the hot layer the threads are drawn out by the combined action of their weight, the flow of water through the funnel, and the winding mechanism. In order to enhance the spinning properties of cellulose dissolved in pyridine, small quantities, 10 to 30 per cent (figured on the weight of the cellulose acetate) of substances such as acetylene tetrachloride, which increases the density of the solution, may be added.

The Relationship of the Modern Dyer to the Ancient Colorist

Art of Color—Beauty of the Colors of the Ancients—Influence of Exploration on Color Development—History of Color Revealed by Research—Artist and Chemist—American Dyes Are Satisfactory —New Colors Depend on Research and Co-operation

By M. D. C. CRAWFORD

Research Editor of Women's Wear, in an Address Delivered at the Annual Meeting of the Textile Color Card Association, February 6, 1924, at the Hotel Astor

YOU cannot change the reactions of the human race to color through the development of mysterious chemical formulas. Color is one of the oldest and most potent sensations the race of man has been subjected to. There is clear evidence that color precedes by many cultural cycles the development of fabrics, pottery and even basketry, the fundamental arts, upon which most of the modern artistic expression depends for its ancestry. There is no question that the painting of the human body was a highly developed art, closely related to the artistic, social and religious lives of many peoples, long before the dawn of these fundamental arts, which themselves can be traced into the twilight zones of human culture. If for one moment I might direct your thoughts to the highly organized tattooing of the Moors or the ritualistic paintings of the Zuni priests, that will be sufficient to prove to what a high degree their arts attained. Color is a species of subtle language and just as the different tongues of the world reach back to other languages and other races and divide themselves eventually into little tribal trickles of speech, so color has come down to us through many changes of civilization up to a certain recent development in the science of chemistry, bringing with it all the richness of former ages. On the other hand, the change may be likened to that which took place when the handcraft suddenly changed to machine technique.

Formerly the weaver's art was restricted to one phase of expression, was, under the sure guidance of sustained traditions, from time to time, stimulated by the gradual intrusion of other arts. Beauty ripened suddenly in the eighteenth century, the great idea of the modern machine was born and the traditions, the individual skill, the pride in craftsmanship, the inherent aptitudes, were all lost in the turmoil of this new development. Many things were lost as well as gained in the century and a half that has passed since the first British mechanics produced their crude but brilliant inventions upon which all our modern machines are based.

When each color was the result of a gradual development of natural dye materials, gradually brought under control by the individual efforts of artist craftsmen, the range of colors was compared to our own limit, but each shade and tone was brought in artistic symmetry, to the existing color understanding and appreciation. The reason why the colors from past ages are invariably beautiful and stimulating is because there was in those times a very gradual addition to each palette and a certain elimination of combinations and individual values, just as important as the additions themselves.

I do not have to plead with such an audience, the aesthetic value of the colors found in the coptic tombs, nor offer proof to you that Persian color of the fourteenth and fifteenth centuries, Italian color of the sixteenth, were of deathless beauty. And it must be borne in mind that this chromatic excellence was not merely reserved for the most exquisite and extravagant expressions of the arts of these people. It was a common heritage, and if it were possible to gather in this room some examples of all the different materials from any one of these periods, it is doubtful if a single object would appear (regardless of its usage or intrinsic value), that would not have an almost equal aesthetic value with all the rest. Personally, I know of no period in the fabric arts of the past, where there was any sure and certain beauty, that this beauty did not extend to every phase of the arts of these people. A really fine color sense is as universal as air—as free as water.

This is not an accident. This was because the colors as well as the designs were the result of understood, carefully nurtured, strictly conserved tradition, and in those ages there was none of the restless quest after nov-

elty for mere novelty value that we find to-day. True it is, that as each of these arts touched the fringe of an neighboring art, through trade migration, exploration, or conquest, modifications occurred in each and there was then, as now, as definite charm in the exotic. At the same time each of these intrusions were slowly and surely incorporated in the existing arts, and these changes in turn became as much a part of the traditions as the original body of the arts themselves.

No event in the artistic history of Europe was of greater importance than the voyage, around the Cape of Good Hope, of Vasca da Gama, in 1497. He brought to Europe the painted cottons and silks of the Orient, and these became familiar objects of trade to such a degree, indeed, that legislation became necessary both in France and England to protect the woolen and silk industries from the devastating competition of cottons. There is no question that many of our present-day textile arts in Europe are the result of attempts of manufacturers in England and Europe to meet this competition, and a great part of the color palette of most dyers, printers and weavers of our ancestors was inspired by an Asiatic source. We can see, indeed, in the Colonial history of America, a trace of the beginnings of the same influence.

A little over fifty years ago the attention of the scientific world was directed toward that great field of arts generally grouped under the term of primitive. With our gradually unfolding knowledge of these peoples in Asia, on the fringe of Africa, and in the New World, our conceptions regarding the origin of the arts, their antiquity, the relationship these bear to environmental life, has considerably modified. Back of almost every art we group under the heading of classical, using this term in its broadest significance, we come at last to a primitive source of origin. The word has ceased to be used in a derogatory meaning and has come to represent the symbol for an art in which we can trace no outside intrusive influence. In other words, the expression of a single people within reasonable limited geographical boundaries we call primitive.

An observation of many years impels me to say that few designs and few colors, even few styles, have enjoyed a rational economic existence, but have been based upon some past tradition, consciously accepted or unconsciously followed. By this I mean that back of each new development in our arts there have been, through some individuals, basic observation and research, followed by a rational creation. The rest have been modifications and copying. Perhaps never in the history of these times has research in the arts of the past peoples and races been so extensive all over the world. There are expeditions in Egypt, in China, in Latin America, in our own Southwest, in the islands of the Pacific Ocean. These expeditions are bringing back not only material interesting to the scientist, but material interesting to the artist.

The great decorative impulse which finds its great expression in Leon Bakst, in the theater and in the fabric arts is based on a sure historical basis. Bakst was, and still is, an earnest student of the past. Scarcely a great French fabric maker but has made a careful study of the history of the art of which he is the living exponent.

There was a time when many men, myself included, maintained the belief that there was some inherent lack of esthetic quality in synthetic dyes which made it impossible to give the fine rich tones and blendings we had become familiar with in the arts of the past. I am convinced that we were in error. There is nothing in the synthetic colors nor in the method by which they are made which prevents them from becoming the basis of a beauty of to-day as great as any the past has yielded us. But we cannot substitute for the artistic dyer the man learned only in chemical formulas. It is to be hoped in the near future, when chemistry becomes less of a mystery and more a matter of common knowledge, when it loses some of its rigidity, if I may use such a term, the artist will be the chemist and the chemist will be the artist.

The Importance of Color

Until that time comes the artist and the chemist must seek some common ground, some sure division of function. And by artist please do not understand me as meaning merely painter or teacher of art. I refer to an individual who looks upon each problem from an esthetic viewpoint. After all, in spite of the amazing dimensions of our dye-making agencies, our fabric mills, our garment factories, great retail establishments, the function of color is unchanged. Color is more than a mere gratification of surface satisfaction. It reaches deeply into the inner consciousness of our nature and into the vague emotions, where even the plummet of the scientist is lost in the wells of racial fundamentals. Who is so bold as to treat this subject as a mere incident of production, a modest hand-maiden of commerce? Who so rash or so stupid as to regard the selection of tones, of values, balance and composition as mere incidents of a sordid impulse toward selling? There is nothing the matter with our dyes; that is, nothing that a few more years of development will not correct. There is nothing the matter with our fabric mills; that is, nothing but what a little greater enterprise and vision will change. We can have fabrics, and constumes, and color as beautiful, as wholly desirable, as any the world has ever seen, if we will do so. If we will give to color the same attention we pay to the selection of fibers, to pattern, to finance, we can get the highest results. And color is infinitely more important than any of these factors. To achieve our highest we must employ many agencies, must synchronize many apparently divergent efforts, and we must be fundamentally sincere in our intentions.

No phase of our industrial life but can well afford

laboratories which are indeed modifications of craft shops, where the artist and the chemist can meet on a common ground. We must be more sensitive to the rising taste of our great audience; and remember, we are living in a great civilization during the ages that this civilization is achieving greatness, not after its greatness has become a matter of historic satisfaction. It is your task to lead this feeling into higher and still higher planes of satisfaction. You have no choice, for if you don't assume this leadership other nations, other agencies, other individuals will do so and leadership will pass from the hands that now hold it. There is no more important problem in the industrial arts of to-day, and I have in mind the movements of raw material, the financial and labor conditions, the problems of international exchange and commerce, when I say this. Color is the dominant note. It can make us; it can destroy us.

One of the surest avenues of approach is through a careful research and analysis in the great decorative arts of the past. Often the thought has come to me that an exhibition, designed purely and simply to show color without reference to the historic or romantic interests of the materials or fabrics shown, might be a great help in this situation. The material is adequate. The resources of this city in collections of this kind is little dreamed of by anyone who has not spent among them years of research. I do not believe that either color or design or fashion can be achieved surely in an inspirational way and placed upon an enduring basis, unless these traditions are understood, and unless each new development in our decorative arts is based upon some inspirational interpretation of the past. I am confident that my associates share my views. I am confident that they are willing to support me in this unusual venture. The condition in the past has been due to a lack of contact between these two forces. It is a great source of satisfaction and pleasure to study the history of color in actual fabrics for thousands of years of civilizations. It is one of the most fascinating of pastimes, and fifteen years so employed still leave me with my pristine delight in this subject. But it cannot become of practical value to the age or to our industries until there is a co-ordination between the institutions which have gathered such material, and the organizations which interpret these ideas in the materials of to-day. Through personal effort, through the friendly interest and enthusiasm of a few men in industry, it has been possible to achieve certain individual results. And I am not minimizing this gradual infiltration of our industries with these ideas, but much more could be accomplished if we met on a common ground of a mutual exchange of ideas, so that no loveliness that the past has achieved in color development, no great traditions of living beauty, might be denied the people of this age through the industries of this time.

FIVE NEW DU PONT COLORS

Five new dye products have been added to the list of those made by E. I. du Pont de Nemours & Co.

A new brown, Pontamine Brown D3GN, similar to their "D3G" brand, but brighter and redder in shade and faster to acid, is said to possess very good solubility, making it suitable for the various kinds of machine dyeing. It is applicable to silk, wool, paper, hemp, jute, leather, etc.

Sulfogene Green 2B, a product that dissolves easily and exhausts readily, is suitable for use in circulating machines. It is recommended as a self-shade or to be used in combinations. After-treatment with chrome, copper and acetic causes the shade to become somewhat bluer, but its fullness is still retained. This treatment increases the fastness to light and washing.

Three vat colors in powder form that have been issued by the Du Pont Company are: Ponsol Black B Double Powder, Ponsol Blue GD Double Powder and Ponsol Yellow G Double Powder, The properties of these in each case are identical to the corresponding paste types.

William J. Ginsty, who formerly was connected with the Geigy Company, Inc., and lately with the Sea Island Thread Company as boss dyer, has become associated with the Yazoo Mills, Inc., dyers and manufacturers of twines and thread specialties as boss dyer.

The Consolidated Piece Dye Works, 67 Ward Street, Paterson, N. J., have been organized to dye, finish and print piece goods of silk and all kinds of yarns. Capital consists of 2,500 shares of preferred stock, par value $100 each, and 2,500 shares of common stock of no nominal value. Henry Smith and others are the incorporators.

DYEING COTTON PIECE GOODS WITH HYDRON BLUE

(*Continued from page* 120)

lay the operation of the process is the slipping and falling off of the driving belt.

Composition of the Dye Bath

In order to obtain a full blue color on goods destined for the manufacture of sailors' uniforms, the dye liquor should be made up in the following proportions. There should be employed from two to two and a quarter parts of Hydron Blue RF, five parts of sodium sulphide, and five parts of caustic soda lye of 38 to 40 deg. Be concentration. After the goods have been passed through the dye liquor three times, two and one-half parts of concentrated hydrosulphite solution are added. When the dyeing is carried out in a bath that does not contain any sodium sulphide, three times the quantity of sodium hydrosulphite is used.

Summary of Patents for 1923

THE following comprehensive list of patents on dyes and colors, dyeing, bleaching and finishing processes and machinery was culled from the Index of Patents for last year, recently issued by the Patent Office. It is intended as a short but almost complete index to those patents which pertain especially to textile processes and which, consequently, should be of particular interest to dyers, textile chemists and dyestuff manufacturers. Complete descriptions of any of the patents may easily be obtained by communicating directly with the Patent Office at Washington.

Dyes and Dyeing

Color dropper. C. H. Hornbeck. 1,471,731; Oct. 23.

Color-identifying apparatus. N. Macbeth, 1,442,166; Jan. 16.

Coloring matter, Disazo, A. W. Joyce. 1,472,333; Oct. 30.

Coloring matters, Manufacture of vat. F. Kacer. 1,459,536; June 19.

Colors in non-aqueous solvents, Producing Azo. W. J. Murray. 1,462,613; July 24.

Colorimeter nephelometer, Combined. J. C. Bock and S. R. Benedict. 1,459,964; May 29.

Dye and making the same. G. S. Bohart. 1,464,802; Aug. 14.

Dye, Blue sulphur. W. A. Manss. 1,471,854; Oct. 23.

Dye, Indigoid vat. W. Bauer. 1,466,687; Sept. 4.

Dye, Production of triphenylmethane. D. W. Bissel. 1,478,015; Dec. 18.

Dye sticks, Snubbing device for. D. M. Giles. 1,476,296; Dec. 4.

Dye, Sulphur. E. Kramer and L. Zeh. 1,449,681; March 27.

Dye, Vat. D. G. Rogers and H. T. Stowell. 1,478,061; Dec. 18.

Dyeing. G. S. Bohart. 1,464,803; Aug. 14.

Dyeing. B. C. Leonardi. 1,457,581; June 5.

Dyeing and otherwise treating yarn with fluids, Rotary perforated beam apparatus for. R. S. Heap. 1,471,658; Oct. 23.

Dyeing and printing textile materials and in general for pigmentation of various substrata and manufacturing the same, Product for. M. Bader and C. Sunder. 1,448,251; March 13.

Dyeing animal or mixed fibers. P. Ounertz and A. Peters. 1,441,240; Jan. 9.

Dyeing cellulose acetate. E. P. Sisley. 1,440,501; Jan. 2.

Dyeing cellulose acetate or products made therewith. R. Clavel. 1,448,432; March 13.

Dyeing, Clamp for producing mottled skein. H. Epstein. 1,461,822; July 17.

Dyeing furs, hairs, and the like, Preparation for. P. Onnertz. 1,453,021; April 24.

Dyeing furs, skins, hairs, feathers, or the like. P. Onnertz, 1,466,747; Sept. 4.

Dyeing, Indigo. E. T. Garsed. 1,449,981; March 27.

Dyeing machine. F. C. W. Stelter. 1,462,129; April 17.

Dyeing machine. P. A. Wagner. 1,441,898; Jan. 9.

Dyeing machines Yarn-stick-supporting member for. J. H. and D. M. Giles. 1,455,247; May 15.

Dyeing or coloring wood and like fibrous material under pressure. J. T. Bouwman. 1,447,528; March 6.

Dyeing, Process and machine for continuous. H. Metcalfe. 1,457,741; June 5.

Dyeing. Production of shot effects, not to be stained in piece. R. Haynn. 1,451,299; April 10.

Dyeing skins, hairs, and the like. O. Kaltwasser and L. Kirberger. 1,460,758; July 3.

Dyeing textiles. H. E. Van Ness. 1,456,344; May 22.

Dyes, Disazo. A. W. Joyce. 1,472,334; October 30.

Dyes of benzene-naphthalene-acridine series and their manufacture. H. Grunhagen. 1,455,488; May 15.

Dyes of the acridine series and process for their manufacture. H. Grunhagen. 1,455,487; May 15.

Dyes of the acridine series and their manufacture. H. Grunhagen. 1,455,486; May 15.

Dyes, Triarylmethane. L. P. Kyrides. 1,478,039; Dec. 18.

Dyestuff prepared from orthoxylylaldehyde. A. E. Craver. 1,470,554-5; Oct. 9.

Dyestuff, Yellow vat. G. Kalischer, J. Muller and D. Nissen. 1,440,833; Jan. 2.

Dyestuffs. M. P. Schmidt and H. Roese. 1,444,277; Feb. 6.

Dyestuffs and lakes derivable therefrom, Compound of monazo. A. Linz. 1,445,331; Feb. 13.

Dyestuffs and making same, Azo. A. L. Laska and A. Zitscher. 1,457,114; May 29.

Dyestuffs and making same, Azo. A. L. Laska and A. Zitscher. 1,457,114; May 29.

Dyestuffs and making same, Black azo. A. L. Laska and A. Zitscher. 1,452,083; April 17.

Dyestuffs and making same, Indigoidic. H. Staudinger, H. Veraguth and R. Tobler. 1,461,435; July 10.

Dyestuffs and making same, Intermediate product for the manufacture of. G. de Montmollin, J. Spieler and G. Bonhote. 1,453,659; May 1.

Dyestuffs and manufacture of same, Azo. G. de Montmollin, G. Bonhote and J. Spieler. 1,453,660; May 1.

Dyestuffs containing sulphur and dyeing vegetable fibers without a mordant and making same. R. Herz and H. Balhorn. 1,452,805; April 24.

Dyestuffs, Manufacture of chromed. F. Straub. 1,440,566; Jan. 2.

Dyestuffs of the triaryimethane series and making same. G. de Montmollin, J. Spieler and G. Bonhote. 1,460,315; June 26.

Dyestuffs, Preparation of. K. Dziewonski. 1,471,150; Oct. 16.

Dyestuffs, Production of vat. L. C. Daniels. 1,464,598; Aug. 14.

Dyestuffs, Production of vat. L. C. Daniels and W. S. Lawrence. 1,478,027; Dec. 18.

Bleaching and Compounds

Alkali cellulose, Preparing. P. C. Seel. 1,469,824; Oct. 9.

Bleaching, Apparatus. C. Taylor. 1,459,697; June 19.

Chlorination, J. B. Marvin, Jr. 1,442,491; Jan. 16.

Chlorine substitution products, Producing organic. C. P. Townsend. 1,468,220; Sept. 18.

Carbonization

Carbonizing compound and making and using it. S. B. Mathewson and W. K. Jamison. 1,471,563; Oct. 23.

Carbonizing machine. W. W. Latta. 1,476,988; Dec. 11.

Detergents

Detergent. H. Spurrier. 1,474,690; Nov. 20.

Fabric Treating

Fabrics and other goods, Machine for treating or processing. J. A. Wilson. 1,457,413; June 5.

Fabrics and the like, Production of coated. H. E. Brown and J. H. Stover. 1,465,541; Aug. 21.

Fabrics, Beetling and treatment of. R. W. R. Mackenzie, E. Robinson, M. Fort and J. D. Lumsden. 1,460,858; July 3.

Fabrics, Composition for removing rust from. A. C. Shaver. 1,457,609; June 5.

Fabrics, Composition for treating. H. J. Sulb. 1,441,952; Jan. 9.

Fabrics, Finishing. J. H. Wrigley. 1,442,840; Jan. 23.

Fabrics, Liquid for treating. A. Neusella. 1,453,764; May 1.

Fabrics, Means for Finishing. A. A. Grundy. 1,462,172; July 17.

Fibrous cellulose for the production of hydrated derivatives, Treatment of. C. F. Cross and E. J. Bevan. 1,459,616; June 19.

Fibrous material, Composition for Treating. W. C. Geer and J. B. Dickson. 1,470,073; Oct. 9.

Fibrous material, Treating. E. Dyckerhoff. 1,446,888; Feb. 27.

Finishing machine. L. A. Babcock. 1,454,031; May 8.

Textile fabrics, Apparatus for drying and carbonizing. P. Glennie. 1,476,362; Dec. 4.

Textile fabrics, Process and device for finishing. E. Edlich. 1,471,551; Oct. 23.

Textile fabrics, Singeing device for. W. Osthoff. 1,443,587; Jan. 30.

Textile material, Method and apparatus for stretching. H. D. Ayers. 1,468,351; Sept. 18.

Textile materials as products, Machine for treating. J. J. Brophy. 1,457,297; June 5.

Textile stock, Apparatus, installation, installation and method for use in treating. W. S. Kingsley. 1,465,046; Aug. 14.

Textile stock, Mixing and Cleansing apparatus for. W. S. Kingsley. 1,465,050; Aug. 14.

Textile substances, Faller or gill bar for treating. J. W. Ryan. 1,463,844; Aug. 7.

Textiles, Machinery for dyeing and treating. F. F. Larivei. 1,454,897; May 15.

Coated fabric. L. Kirkpatrick. 1,468,818; Sept. 25.

Coating and drying fabrics and other material, Method and apparatus for. P. S. Smith. 1,470,650; Oct. 16.

Sizing composition. R. Kaiser. 1,448,847; March 20.

Sizing compositions and preparing same. P. W. Codwise. 1,449,892; March 27.

Sizing solution and making same. J. A. De Cew. (No date.)

Testing

Testing materials. L. Ratner and M. Schwarz. 1,444,803; Feb. 13.

Testing materials, Method of and apparatus for. F. W. Sperr, Jr. 1,444,567-8; Feb. 6.

Testing the fading action of light, Apparatus for. C. W. Jameson. 1,458,941; June 19.

SURPLUS DYESTUFFS FOR SALE

3,790	pounds	Chrome Fast Blue 2R (Swiss)
1,390	"	Aminogene Blue RN (Swiss)
836	"	Curcuphenine (British)
11,000	"	Sulphur Green
20,000	"	Sulphur Brown
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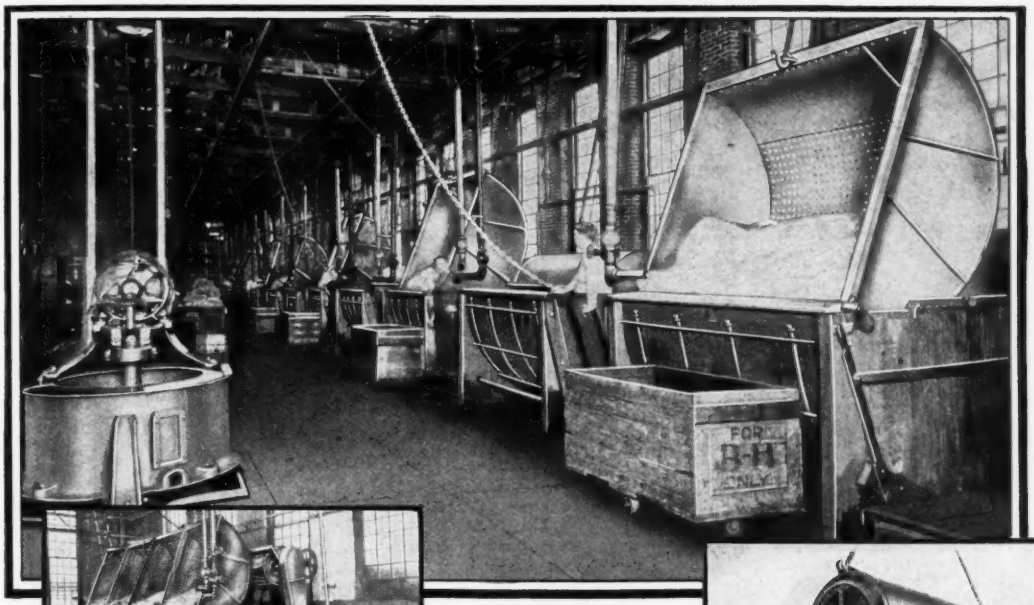
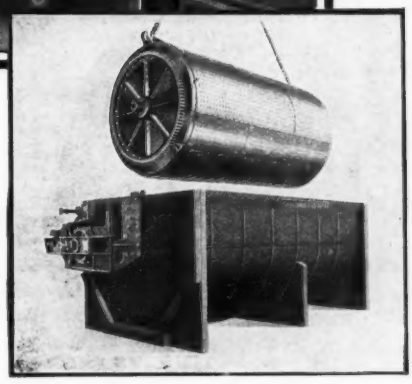


12—400 lb. capacity Monel Metal paddle dyeing machines in plant of Taubel, Scott & Co., Riverside, N. J. At left—2000 lb. capacity Monel Metal paddle dyeing machine in same plant. All made by SMITH, DRUM & CO., Phila., Pa.



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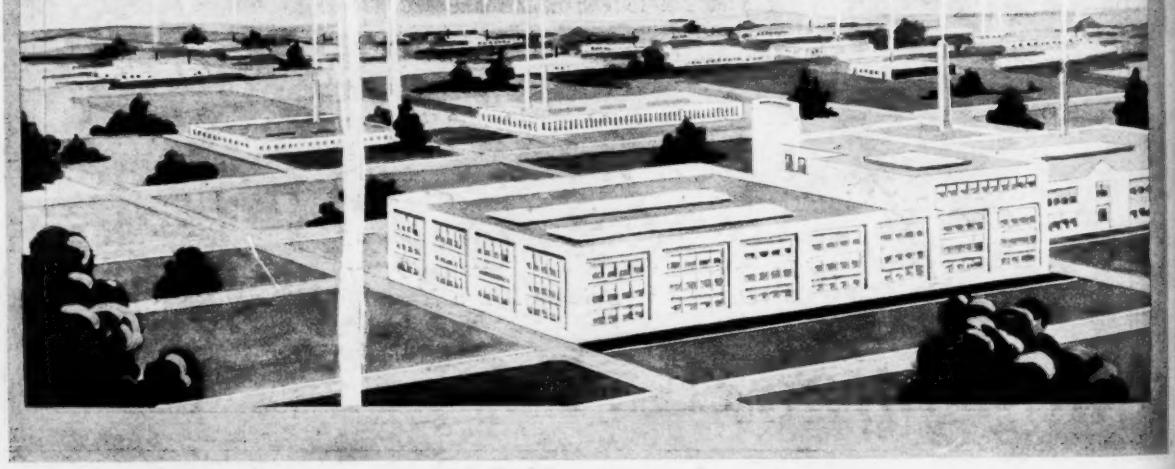
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